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Early-Day Copper Mining in the Globe District of Arizona

By Arthur L. Walker

Fundamentals in the Development of Metallurgical Plants

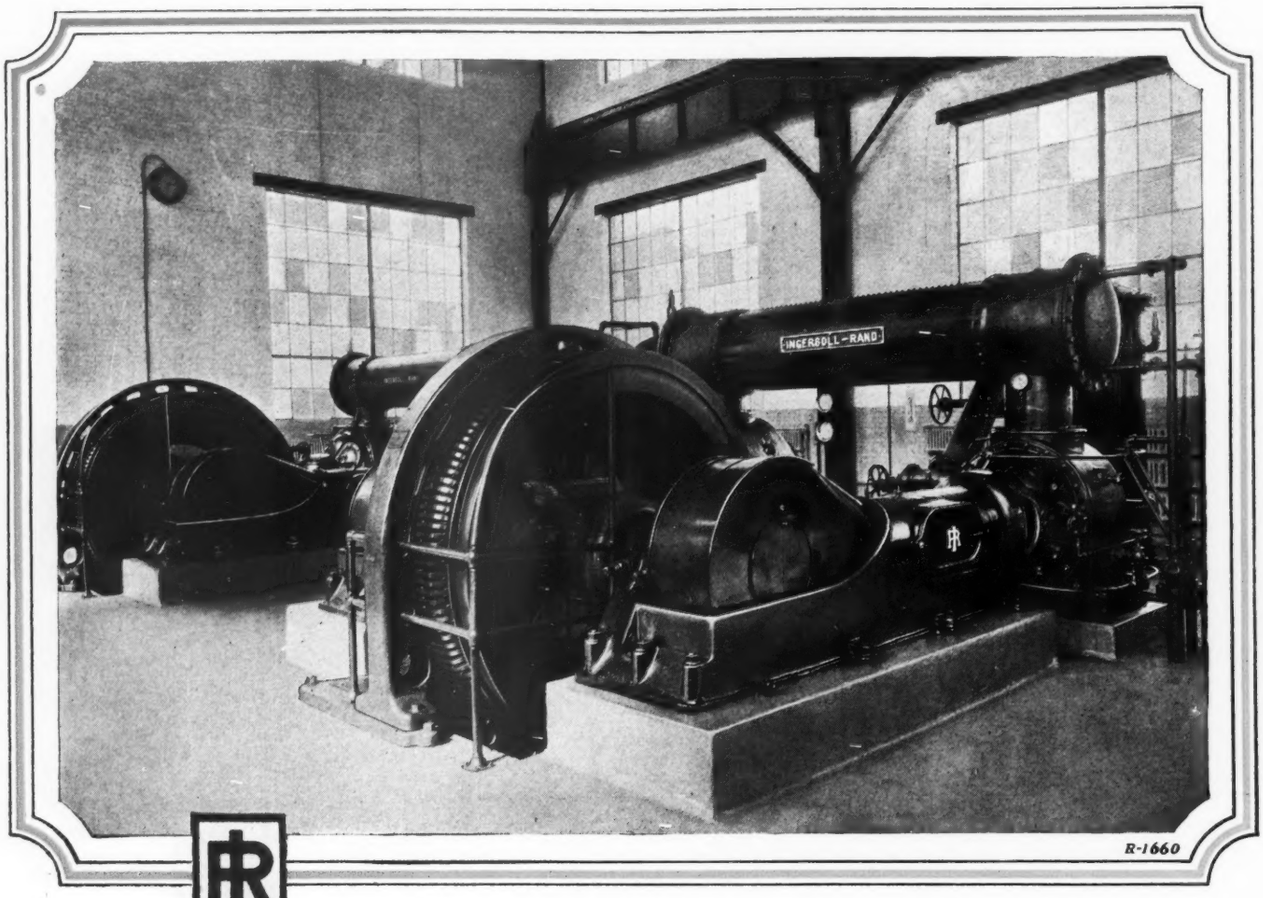
By H. M. Lewers

Cost-Saving Methods Adopted by United Verde

By E. H. Robie

Why Let Mine Timber Decay?

—A Bureau of Mines Study



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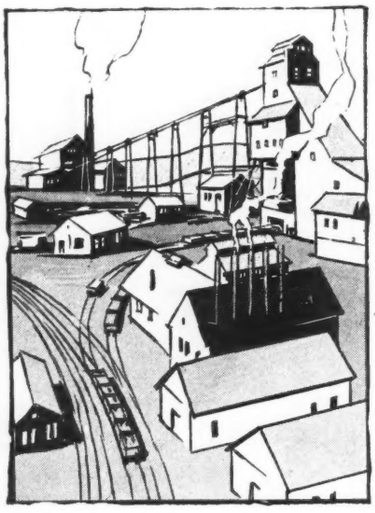

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The Dam Disaster in California and Professional Co-operation

THE recent failure of the St. Francis Dam in California, with resulting loss of life and property, has attracted widespread interest, especially among the engineering fraternity. Its collapse evidently resulted from the failure of the foundation rock under the west side of the dam and near the abutment section. The concrete was apparently sound. Water infiltration was doubtless the cause for the initial weakening of the foundation rock.

At a recent meeting of the American Association of Petroleum Geologists at San Francisco, Mr. H. R. Johnson stated that an old fault line was directly beneath the dam. The foundation rocks, according to him, are schist, black gouge, and red conglomerate, the schist being faulted down against the conglomerate. Mr. Johnson pointed out that fault planes are water carriers as well as lines of weakness. This brief report of Mr. Johnson's emphasizes the need for careful geological studies in advance of engineering projects that involve important structures such as dams, tunnels, reservoirs, and the like. In many instances this is done, but no important construction work of this nature should be commenced until a geological study has been made. The action of rock masses when dry and when subject to infiltration, to recurring and to continuous stresses, is not well understood and should be investigated.

Unfortunately, the disaster in California has been made the text for illogical deduction and pseudo-scientific recommendation. "Once more," a newspaper states editorially, "neglect of colloid chemistry seems to have brought disaster in its train . . . To detect such dangers in advance," we are told, "is one of the duties of the expert in colloids, a duty that the builders of the St. Francis Dam seem to have discharged imperfectly." Apprehensive terror will result at the thought of an obvious question: How many dams now in operation have been constructed without the advice of this new chemical expert?

Then follows a paragraph that attempts to define the word colloid. "Wet clay is a colloid, consisting of millions of fine solid particles separated by tiny films of water," the public reads, in contradiction of the recognized fact that it may possess no colloidal characteristics whatsoever, wet or dry. After an attempted diagnosis of the trouble in California, the author of the editorial in question states that "In the ground beneath the St. Francis Dam the particles seem to have been grains of sand and clay imperfectly hardened into rock. Thin cracks among these millions of particles let the water enter." And then comes an anti-climax worthy of the worst in popular "science": "Thus the supposed hard rock became a colloid, grew partly fluid, let the dam collapse."

Seepage was probably partly or wholly responsible for the disaster, but no colloid can be manufactured by the addition of water; and the need for the services of a colloid chemist would suggest itself only to one who was already a colloid enthusiast. Mistakes are made by all who are not dead or out of the running, but the engineer and the geologist are surely capable of anticipating the effects of water on foundation material and of forecasting results without assistance from a professional group that in recent years, by vigorous propaganda in magazines and newspapers, has inferred that it should have a finger in every technical or engineering "pie."

Our own profession and industry, as one that has contributed in major degree to the advance of civilization and the comfort of humanity, has yet to embark on a scheme of professional publicity. What is the matter? Is it that the conviction is widely held that a "shrinking-violet" attitude is the only one compatible with professional dignity? Or does the majority refuse to realize the value of advertising the industry and proclaiming the ability of its geologists and engineers? Success, individual or corporate, is rare without expressed confidence and the abandonment of that natural personal timidity which in recent years has been divorced so successfully from the profession of chemistry.

Equipment From Abroad

EQUIPMENT that is practically new in American practice was described in the Industrial Progress pages in last week's issue of *Engineering and Mining Journal*. The steam accumulator is referred to. By it the heat energy produced in a steam-power plant at any moment in excess of steam requirements may be stored, to be drawn upon whenever the situation is reversed and the demand for steam exceeds the output of the boilers working at their average rate. The accumulator thus makes it possible for the plant running at its average rate to handle peak loads of limited duration which, without its aid, would necessitate driving the boilers to capacity at intervals, or else installing much larger units than the average load requires. It resembles the flywheel of an engine in its ability to store energy to meet the demands of a fluctuating load.

Keen competition and the high cost of coal led to the adoption in Europe of the principle of storing heat in an accumulator more than ten years ago, and the number of units installed has steadily been increasing, according to report. On this side mechanical engineers are said to be comparatively unfamiliar with this equipment. Its introduction into the American field is therefore worthy of attention.

Likewise of interest is the invasion of the domestic

electrical-equipment field by foreign switchgear of a type radically different from that customarily used in the power plants in the United States. British it is by "birth," but it has been naturalized, inasmuch as its introduction here is being sponsored by a well-known manufacturer. Among the advantages claimed is that it is perfectly safe. The workman cannot possibly come in contact with live parts, and he is also protected against burns from arcking. This alone is sufficient to obtain respectful consideration from engineers and other technical operatives for this new switchgear.

Educational Value of Mining Conventions

A MINING CONVENTION such as that recently sponsored by the Northwest Mining Association and held at Spokane, apart from bringing together mining men, technicians, prospectors and the mining educational fraternity, has a distinct value in other respects. Grievances and difficulties are aired and constructive suggestions are made. The organization is available to further the interests of the industry and to work for changes that may be greatly needed. In the small talk that accompanies the more formal topics, mining men learn from each other of successes and failures, and the reasons why and wherefore. The critical need for transportation facilities in some district is made known; novel methods of operation are disclosed; difficulties in financing are stressed; new properties are discussed; and the merits of improved mechanical equipment are told. Much information is traded. A mineral exhibit, a feature of the Northwest convention, attracted large numbers.

Improvements in metallurgy and the changed status of custom plants were brought to the attention of mining men attending the Spokane meeting. Information about the scope and success of selective flotation was not overlooked. As a result, those in attendance could determine the advantage to their properties that might arise by adopting improved metallurgy in the treatment of the ores mined.

Meetings of this kind also serve to interpret the mining industry to the general public. This industry is of fundamental importance to many communities and states. The greater numerical strength of the elements comprising agriculture is a potent factor in stimulating public interest in that industry. Efforts should be made to keep the mining industry—its needs and its importance—constantly before the public.

Ethyl Gas and the Dangers of Lead Poisoning

DISQUIETUDE has been caused in Great Britain by the introduction on the British market of ethyl gasoline as a motor fuel, according to *The Mining Magazine*. At first, this is surprising to those who recall the controversy over lead tetraethyl in the United States in 1925, and the subsequent investigation that was inspired by the Surgeon General of the Public Health Service. A committee appointed to study the matter found no good grounds for prohibiting the use of this variety of motor fuel, provided proper control was exercised in its manufacture.

It might be supposed that the British public was unaware of this investigation, but such is not the case. "It must be acknowledged," says *The Industrial Chemist*, London, with reference to the refiners, "that the American investigation encouraged them to carry on with the manufacture and sale of the petrol. Whether these investigations need amplifying will, of course, be discussed by an examining committee. . . . While one is inclined to agree that, taking the proper precautions, ethyl petrol is not a health hazard, it is just these proper precautions that are so difficult of enforcement when dealing with a nation as a whole. . . . Warnings are useless. . . . The new petrol must not be more poisonous than the old."

Beholding this apprehension across the water with the memory of our own fears and their subsequent dissipation so fresh in mind, we must make allowance for the difference in national temperament. Our British friends are more conservative, generally speaking, than we are, and far more serious-minded. It might be expected that they would wish to study the matter for themselves. Besides, it will do no harm to reinvestigate the subject in a new environment. Whatever be the outcome, the lead market will scarcely be disturbed. The amount of the metal consumed in the form of ethyl gasoline is insignificant, and present indications warrant the conclusion that it is likely to remain so.

Fifty Years' Dividends and Still Going Strong

A GOOD mine dies hard. About four years ago it was whispered that the Homestake, in the Black Hills of South Dakota, which had been paying dividends almost continuously since 1879, had become "a liquidating proposition." It took no elaborate calculation to discover, on the basis of published ore reserves, that at the then current rate of production only sufficient ore remained to last for 11½ more years. The price of the shares dropped to $35 in the summer of 1924, though in that year the company increased its dividends from $6 per year to $7, since maintained. That made a nice yield, as any present-day Wall Street operator would readily admit—something better than 20 per cent on one's money.

Now comes the best Homestake report in years. Based on current production, the mine still boasts of 11½ years' ore reserves, as four years ago, though the actual tonnage is a little less. The profits made by the company in 1927 rose considerably—because the grade of ore treated increased to $4.87 per ton, compared with only $4.10 last year, and from $3.66 to $3.87 for the three years before that. No comment is made in the report as to whether the increased grade can be maintained or not; if so—if $4.87 is anything like the grade of the fifteen-odd million tons of ore that remains in the mine—the stockholders are a good deal better off than they had any right to expect. Some companies hold back information in their effort to keep bad news to themselves; it would appear that the Homestake leans over backward in its conservatism, and prefers an occasional pleasant surprise for its stockholders.

The recent reports make it clear that Homestake is far from dead. One fancies that little will be heard about its being "a liquidating proposition," for a time, anyway. If the ore reserves decrease no faster than they have

for the last four years, the company will still be in business at the old stamping ground in 1970. This, of course, is unlikely, but it would be interesting to the stockholders to know more about the possibilities for finding new ore.

Incidentally, it was just fifty years ago that Homestake levied its first and only assessment, from the proceeds of which it built its first mill.

Should the Patent Office Be Abolished?

CONFLICTING viewpoints mark the various expressions of opinion published in recent months anent patenting in general and the Washington Patent Office in particular. One observer considers that the existing patent system should be abolished "root and branch," believing that the development and welfare of the country would benefit thereby. The publicity concomitant to the issue of a patent is assailed as a concession to the public at the expense of the inventor, who has only one privilege—to fight infringers in the courts—if he has the means or can enlist financial backing. An answer to this is that an inventor can insure the fruits of his initiative against infringement; but difficulties will be foreseen in putting such a plan into practice on a comprehensive scale. Nevertheless, the basic idea has merit.

One of the greatest advantages in applying for a patent is that it forces the inventor to describe his invention without reservation. It is an excellent test, to determine originality as well as practicability in most instances. Moreover, the mere statement of specifications and claims will usually reveal defects and suggest modifications or improvements in practical application, or extensions of use. Many a valuable invention has resulted as the outcome of an idea of little technical merit and perhaps no financial value, but itself patentable. Invention, like all other worth-while phases of human activity, is or should exemplify a natural evolution of orderly thought. To discourage patenting is to discourage advance. To abolish the Patent Office would mean the suppression of initiative among that class from whom most of the great inventions of the world have come. It would merely encourage a secrecy that is a foe to industrial and national progress.

Coarser Grinding and Reduced Operating Costs

WHEN low metal prices prevail it is customary for the operator to make a closer scrutiny of his plant in the hope of reducing costs. Flotation has provided many opportunities for economy; but the present high efficiency of the process makes it more and more difficult to improve the method of treatment. In the intense search of the past decade for new reagents to improve recoveries and to yield cleaner products, it appears that the cost of preparing the ore, the fine grinding step in particular, has received inadequate attention.

A survey of the situation reveals that at many plants the most serious loss is in material of 300 mesh or finer. The added expense of fine grinding involves increased waste of recoverable metal. Operators are becoming cognizant of this condition, but the problem is circumscribed by the necessity for complete comminution of the mineral particles. A factor in the tendency toward over-sliming has been the ease with which modern equipment can handle this fine material. However, manufacturers have recently reported progress in the development of flotation equipment to treat coarser sizes. At one of the big copper properties of the West a large saving has been reported by the use of a flotation cell that permits the treatment of a pulp much coarser than heretofore, with consequent simplification of flow sheet and reduction in milling cost. Reports come from a small mill in Colorado of the flotation treatment of a minus-14-mesh pulp, producing a concentrate containing plus-48-mesh material, with a recovery of 93 per cent of the major valuable metal. Conditions at this plant are exceptional, undoubtedly; but others may well investigate, particularly in view of the operating economies effected and the prospects of continued low prices for some of the non-ferrous metals, with no proportionate reduction of the general commodity-price level.

Influence of Quality and Applicability of Mine Products

THE practice of this publication to quote prices upon both "Lake" and electrolytic copper was discontinued in 1914. An editorial in the issue of May 9 of that year stated that the production of electrolytic copper so far outpaced that of Lake that the latter constituted only one-eighth of the total. In 1907, Lake copper averaged 0.66c. per pound more than electrolytic. Early in 1914, the difference was 0.25 to 0.50c. This is an example of a preferential market established by the position held by this metal with the copper fabricators. The fact that electrolytic copper is of high purity and possessed of the required physical properties eventually brought both to a common price level, except in special instances where the "impurities" in Lake give it a slight advantage.

The possibility of developing preferential markets for metals and minerals is one that should not be overlooked by mining and refining companies. Not only must the probability of enhanced price be considered, but there is also the advantage of maintaining a favorable marketing position with reference to competitors. The use of metals and minerals of high purity and uniformity is a guarantee of similar qualities in products manufactured from them. Obviously, it is to the advantage of the manufacturer of such commodities to purchase a high-grade and standardized product.

Much the same reasoning applies to sand, rock, and gravel. An effort is now being made by the Southern California Rock Products Association to maintain uniform grades, but the total capacity of existing plants is more than twice the normal market demand, and keen competition is in evidence. Materials of good grade compete with those of inferior grade. One solution of the difficulty appears to be the establishment of a preferred market position for the better grades. This can be done by an educational campaign having for its objective the dissemination of information to buyers and users. Good materials give better structures. Likewise, in the nonmetallic and clay industries, important advantages in marketing can be secured by grading and standardizing.

Early-Day Copper Mining in the GLOBE D

Wood for use in the boilers for generating steam was brought to the mine and smelter on burros carrying an eighth cord per load.

WHEN I went to Globe, Ariz., in 1883, to fill the position of chemist and assayer for the Old Dominion Copper Mining Company, it seemed to me, a tenderfoot School of Mines graduate, that I was going very far away from the realm of civilization. Railroad trains ran in a slow and most leisurely manner in those days, and there was a long stage ride from the Southern Pacific Railroad to Globe, or, rather, "Globe City," the euphonious name by which the camp was then called. It took just twice as long to go from New York to Globe as it does now.

I arrived on Aug. 1, after a 24-hour stage ride through the heat and dust of the plains during the day and the penetrating cold of the Pinal Mountains at night. I then thought how much nicer and more pleasant it would be going out on my return trip by the railroad which was promised in a few months. I stayed in Globe ten years, four as chemist and then mine engineer, and six years as general superintendent, but the railroad did not materialize till 1898, five years after I left.

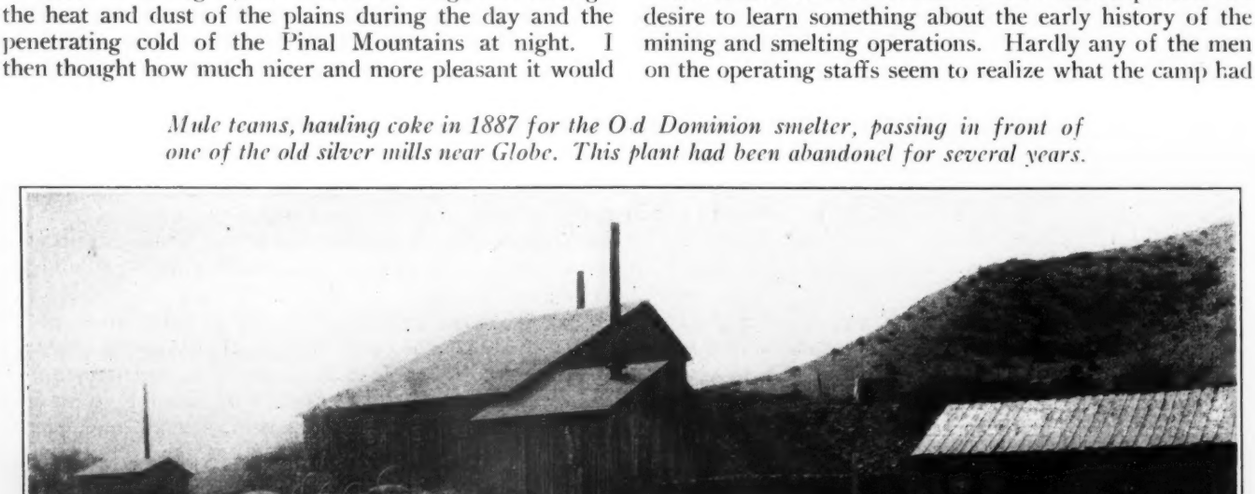
The town and surrounding country boasted of a population of about 1,500 people. It had been greater during the silver excitement of the two years preceding, but in 1883 silver mining was at a low ebb; and thereafter became a matter of historical interest only.

Apache Indians and cowboys were plentiful, and the most important part of many of the men's everyday costume was a long six-shooter. I soon came to the conclusion that I could do very well without such an impediment, as I had no special yearning to shoot anyone, and if someone desired to take a crack at me he could pull his gun very much faster than I could.

Last summer, while on a trip through the West, visiting metallurgical plants in a number of states, I included Globe in my itinerary and went back to my old stamping ground. I must say that I felt somewhat like a modern Rip Van Winkle. Gone were the cowboys completely; gone were the Indians mostly, and a horse was about as rare as a motor car would have been 45 years ago. Instead, there was a constant stream of automobiles passing through the streets of Globe bent on short or long trips, utilizing the excellent roads of which Arizona can now boast.

While at Globe one of the officials I met expressed the desire to learn something about the early history of the mining and smelting operations. Hardly any of the men on the operating staffs seem to realize what the camp had

Mule teams, hauling coke in 1887 for the Old Dominion smelter, passing in front of one of the old silver mills near Globe. This plant had been abandoned for several years.



Reminiscences of PROF. ARTHUR L. WALKER

DISTRICT *of Arizona*

cial quantities, the most promising mines being the Rescue, Centennial, the McMorris, in Richmond Basin about 12 miles north of Globe; the Fame, the Isabella, the Stonewall Jackson, at McMillanville, 20 miles northeast of Globe, and others.

Frequently large nuggets of solid silver chloride were picked up on or near the surface in the Richmond Basin district, and from the Stonewall Jackson mine masses of almost pure crystallized native silver were extracted. One of the numerous rumors I heard in the early days had it that a wonderful vein of solid native silver, several inches thick, had been found on the footwall

On the right of the photograph, which was taken in 1888, is the old Isabella mill used in the early days for treating silver ore. Pinal Creek is on the left. On the sky line in the center and about half a mile distant are several houses. These were in the town of Globe. Now all of the ground shown except the top of the hill on the left is built up.

passed through 40 or 50 years ago. The few "old-timers" that are left are exceptions; and it gave me great pleasure to meet some of them again. F. Juliff, timberman; J. Anderson, engineer; "Con" Crowley; W. Brookner, now county treasurer; George Wilson, a prominent banker; Al Kinney, former host to many visitors at Globe; and others, are still there.

Though the copper mines in the vicinity of Clifton, Ariz., were discovered and located in 1870, the earliest mining location in Globe was in 1874, when Benjamin W. Regan located the Globe and Globe Ledge claims. In 1875, Regan, Mason, and others, when visiting these claims, returned by way of the old Stoneman trail and discovered the famous Silver King property at the foot of the Stoneman grade about 25 miles west of Globe.

The Globe claims were not located for copper, but for silver; and, as but little of the latter metal was found, these claims, afterward the backbone of the Old Dominion company, attracted but little attention. Copper was not considered worth while, and the early history of mining in Globe and vicinity was connected with prospecting for, and discovery of, gold and silver ores. Many mines were located and operated with greater or less success. A number of them produced silver in commercial quantities, the most promising mines being the Rescue, Centennial, the McMorris, in Richmond Basin about 12 miles north of Globe; the Fame, the Isabella, the Stonewall Jackson, at McMillanville, 20 miles northeast of Globe, and others.

Frequently large nuggets of solid silver chloride were picked up on or near the surface in the Richmond Basin district, and from the Stonewall Jackson mine masses of almost pure crystallized native silver were extracted. One of the numerous rumors I heard in the early days had it that a wonderful vein of solid native silver, several inches thick, had been found on the footwall of the Stonewall Jackson mine, and that a sufficient amount of silver had been obtained from one blast to make a carload shipment to San Francisco.

Many of these mines had their own mills located up in the hills or in the valley along Pinal Creek. The photograph of the Isabella silver mill (taken, as were the other photographs used to illustrate this article, by the writer 40 years ago) shows the general type of construction. In the background of this photograph can be seen one of the early copper smelteries, which was operated just long enough to produce a sufficient amount of slag to cover the ground in front of the building.

From the late 'seventies till 1882 Globe had excellent prospects as a silver-producing camp. The mines were being developed extensively, if not always wisely; and mills were built that proved to be examples of misplaced confidence. Unfortunately, the ore found on the surface did not extend to any depth. This was proven in the McMorris mine, where extensive development, including shafts sunk to a depth of more than 800 ft., failed to find ore. Mr. Flandin, a courteous French gentleman who was agent for the mill at Wheatfields, 12 miles north of Globe, where the ore from the McMorris mine at Richmond Basin had been milled, told me in 1883 that

Surface workings of the Globe mines, Old Dominion Copper Company, looking southwest, 1889. The diabase footwall of the vein, which has a dip of 55 deg. to the southeast, as shown by the dotted line, and the outcrop of rich siliceous ore 30 ft. in thickness, can be seen on the right. The old hoisting plant at the Mooney shaft in the center.

Globe would never be a silver-producing camp; that the only silver ores in the district were on the surface; and that most of these deposits had already been worked out. Time proved that his prophecy was absolutely correct.

The value of the copper in Globe ores was first noticed about 1878. The *Arizona Silver Belt* called attention to the extensive and rich bodies of copper ore revealed by what were then very superficial workings on the Globe and Globe Ledge claims. In spite of the fact that these superficial workings showed a large amount of high-grade copper ore, the claims seemed to have attracted little attention until 1881. The *Arizona Silver Belt* was founded and most ably edited by Judge Hackney, a pioneer of great ability, and with unbounded faith in the future of Globe and Gila County. This paper was a great asset, its aim being to further the interests of the district in every possible manner. After Judge Hackney's health failed, Joseph Hammel, a worthy successor, became editor.

The Globe mines were allowed to lie idle for a long time, being worked only in an intermittent manner, and in 1881 were sold to a company which operated them under the name of the Globe Mining Company, but even then only to a limited extent. Prior to this the Old Dominion Copper Mining Company was organized to operate the Old Dominion and Keystone mines, situated about 4 miles north of Globe. In these mines was found a thin vein of ore rich in copper and containing quite a little arsenic; in fact, sufficient to produce copper bullion containing sometimes as much as 5 per cent arsenic. The ore also contained native silver and native gold, and very beautiful specimens, with particles of free gold visible, were taken as "samples." The mines were never profitable, however, and, although they were operated for several years, the total amount of ore extracted was comparatively small. Most of this ore was treated at a small smelting plant situated about 6 miles west of Globe near the Miami flat. The same smelter also treated some ore from the New York and Chicago mines, that were located near by in the vicinity of the "bloody tanks," celebrated as the site where General Crook, in one of his Indian campaigns, surprised and killed a large band of Apache Indians.

About 1882, the Old Dominion property, the New York and Chicago mines, a number of claims located near Lost Gulch, north of Webster Gulch, near the present location of Inspiration mill, and the Globe mines of the Globe Mining Company were sold to M. H. Simpson, of Boston, who operated them under the name of the Old Dominion Copper Mining Company. The small smelter was moved to a point about one mile north of Globe, so that the ore from the Globe mines could be handled easily, and these furnished, even at the beginning, a large percentage of the ore smelted. The remainder came from the other claims of the company. From this time on, the Globe mines were energetically developed, and owing to the fact that they were operated by the Old Dominion company, the old Globe mines later became generally known as the Old Dominion mines, and the original mine of that name was practically abandoned.

The company had a checkered financial career and was, in the early days, often in straitened circumstances. We frequently wondered what would happen on the next pay day, as the reports we heard from the East were most discouraging. It was quite a relief to us to learn in the early part of 1884 that a change had been made in the officers of the company. George A. Pope, of Pope, Cole & Company, of Baltimore, was elected president, and Mr. Hanicle, secretary and treasurer. Messrs. Pope, Cole & Company had been receiving, refining, and selling the copper produced by the Old Dominion company, and their standing was so high it was felt that with Mr. Pope as president the financial difficulties of the Old Dominion must be over. This, however, was not the case, owing to the fact that Pope, Cole & Company had made extensive advances to several companies from which they received copper, and a financial situation developed which forced that company into bankruptcy. The Old Dominion was one of the companies to whom advances had been made, and in settling up the affairs of Pope, Cole & Company a judgment was obtained, to satisfy which the property of the Old Dominion Copper Mining Company was sold to William Keyser, of Baltimore. By this sale the company passed into strong hands and at the same time the interests of the principal owners of the property were amply protected.

During this period a Mr. Thomas, from the Lake Superior country, was superintendent. In 1884 he was succeeded by Alex Trippel, a graduate of the University of Zurich and an able metallurgist, who remained in charge until the end of 1897. I served under Dr. Trippel for four years and the training I received during that period was of inestimable value to me in later years.

In December, 1887, a reorganization was effected under the name of the Old Dominion Copper Company, of Baltimore, with William Kayser as president, and from that time until the property was sold to the Lewisohn Brothers in 1895 the mines were operated practically continuously and with very profitable results. Pig copper ready for shipment to the East was produced at a cost ranging from 5.26c. to 7.19c. per pound of copper, as will be seen in the tabulated costs sheets in the concluding article. The Lewisohn Brothers transferred the property to the Old Dominion Copper Mining & Smelting Company, of Boston, and though the mines were not operated in 1895, work was resumed in 1896 and, except for a period in 1897 and 1898, when operations were stopped pending completion of the railroad, the property has been operated continuously since. Between 1888 and until the property was sold to the Lewisohns, in 1895, the Old Dominion Copper Company abandoned the claims near Lost Gulch and acquired, by purchase for comparatively small amounts or by relocation, properties adjoining the Globe mines, so that it owned a group of ten claims in that vicinity.

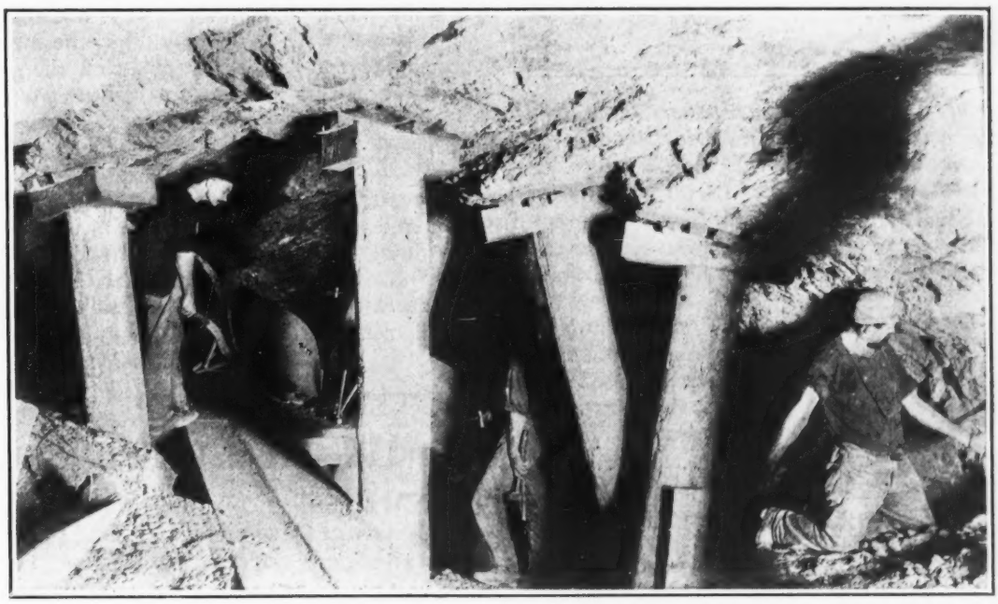
During the period from 1880 to the early part of 1883 a number of other copper mines were discovered and developed. Some of them became producers, the most promising being the Buffalo, lying just north of the Globe mines, the Long Island properties northeast, and the Tacoma, further away in the same direction. Three or four small smelters were built to treat the ore from these properties, but the duration of their active career was short, and in or before 1883 they were all shut down. The ore produced by the mines was of too low a grade to be smelted at a profit under the conditions then existing. Later on, after the railroad reached Globe, these and other mines were reopened and became important producers.

The copper ore in the Globe mines has in later years been divided on genetic as well as practical grounds into oxidized and sulphide types. In the early days, however, the ore was divided into three classes: (1) Siliceous oxidized ore, (2) basic oxidized ore, which occurred in extensive bodies throughout the mine; and (3) sulphide ore, of which there was very little, the first regular seam or vein having been encountered between the sixth and seventh levels.

Siliceous ore, with a high copper content, occurred in more or less irregular veins along the footwall, sometimes in large bodies, from the outcrop to what was in 1893 the lowest level, the seventh. The surface outcrop of siliceous ore, a magnificent body about 30 ft. thick, contained from 20 to 30 per cent copper, the remainder being, principally, silica. On account of its high silica content it was for many years considered impossible to smelt it, and not until 1888 and 1889 was it mined, mixed with suitable flux and smelted. The result was most profitable.

The basic oxide ore, which contained a high percentage of iron and was to a certain extent self-fluxing, occurred in large bodies on the first, third, sixth, and seventh levels. It was easily mined and carried little waste, but the ground on the sides and roof of these bodies was so soft that it had to be securely timbered, and at that time heavy square-set timbering was frequently used. This was the only class of ore mined and smelted in the early years, as, on account of the high cost of coke, it was deemed inadvisable to use barren flux such as limestone in the furnace. Afterward the oxide ore and siliceous ore were used in about equal quantities, and from 20 to 30 per cent of limestone flux was added to the ore in order to make a good smelting mixture.

Sulphide ore was very rare and was found only in small veins. On the seventh level, however, a thin seam of sulphide was discovered assaying high in copper—from 40 to 60 per cent. It occurred in such a small quantity, however, that when mixed with the other ore



A stope in one of the smaller orebodies on the upper levels where the soft roof was supported by heavy stulls, caps and wedges.

only an occasional film of matte on the surface of the copper pigs was produced. The photographs accompanying illustrate the different methods used in mining in the early days at the camp.

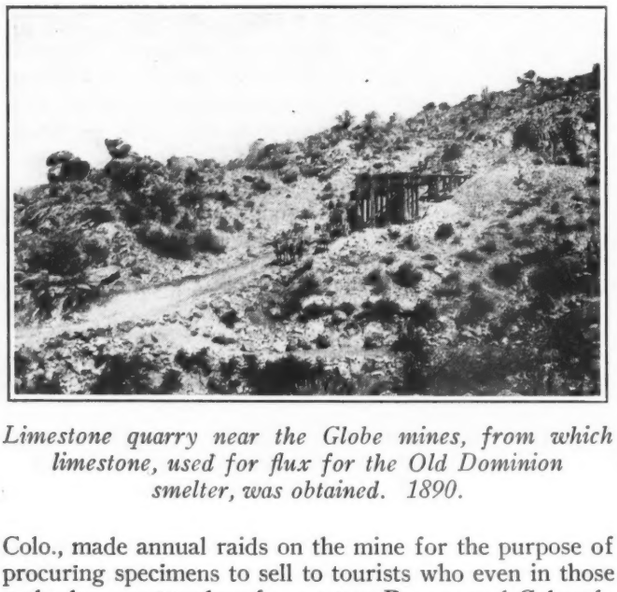
The grade of the ore mined in the early days was of course high, as shown by the following analyses. The grab samples taken for these analyses were not dried and only approximately represented the average ore charged to the furnaces during the periods given.

Average Composition of Ore Smelted, 1883

	Sept. 11 to 18	Sept. 19 to 30	Oct. 1 to 10	Oct. 11 to 27
	Per Cent			
SiO_2	22.8	20.2	25.4	20.8
Fe_2O_3	37.2	42.1	26.6	39.5
Al_2O_3	3.0	4.1	9.6	4.3
MnO	0.4	1.6	1.1	1.5
MgO	0.7	2.8	1.1	0.8
Copper	18.1	13.6	18.4	15.6
Loss by ignition	12.7	9.7	12.7	11.1

The ore delivered to the smelter was not accurately sampled, as there was no sampling mill.

Very beautiful specimens of azurite, malachite, chrysocolla, cuprite, and crystallized native copper were found in abundance throughout the upper workings of the mine. These specimens were much sought after by mineralogists, and Mr. Hiestand, from Manitou Springs,



Limestone quarry near the Globe mines, from which limestone, used for flux for the Old Dominion smelter, was obtained. 1890.

Colo., made annual raids on the mine for the purpose of procuring specimens to sell to tourists who even in those early days ventured as far west as Denver and Colorado Springs.

The geology of the Globe mines is described at length and in an admirable manner by Dr. Ransome, and it is simply necessary to state here that, in the group of which the Globe mines were the principal ones, the footwall was an eruptive diabase having a dip to the southeast of from 45 to 55 deg. and a strike to the southwest. On this footwall occurred a regular and ever-present talc slip. The hanging wall was limestone. The orebodies in the thick vein between these two walls had a general dip to the southwest, were extremely irregular, and sometimes extended hundreds of feet into the hanging limestone. To the southwest of the outcrop on the Globe mines the ground was covered with an irregular sheet of dacite (termed trachyte in the early days), and it is under this flow of dacite that the principal faults to the southwest occur.

The Globe mines were first developed by sinking the Moony shaft on the footwall and at a point about 500 ft. southwest of the big siliceous outcrop. From the shaft the first, second, third, fourth and fifth levels were opened and some intermediate drifts and crosscuts run. Another inclined shaft was sunk on the footwall about 350 ft. to the southwest and a vertical shaft in the hanging wall about 500 ft. east of the Moony incline. Practically all the ore mined from 1881 till 1888 came from the ground served by these shafts.

In 1888, it was decided to sink a vertical shaft on the Interloper mine, a narrow piece of wedge-shaped ground, southeast of the Globe Ledge mine and between the latter and the Southwest Alice. The shaft was about 1,000 ft. from the Moony shaft, almost due south. At this point, several hundred feet southwest of the old workings, we expected to find the orebodies in the main vein at a depth of about 450 ft. below the outcrop, and to develop them in such a manner that the ore could be more cheaply extracted than would have been possible through the old shafts to the north and northeast.

The sinking of the Interloper shaft was in a considerable measure the turning point in the history of the Old Dominion company, as the work accomplished in this vicinity proved the continuance of the orebodies to the southwest, and from the shaft development work was prosecuted in such a way that the supply of ore for the future was assured.

It was at this time that the water problem in the mine was first met and after a hard struggle temporarily overcome. At a depth of 272 ft. from the top of the shaft a large flow of water was encountered—more than the pumps installed could handle. Large bailing tanks, attached to the cages, were used to assist the pumps, and by heroic efforts the shaft was sunk to the sixth level, 293 ft. in depth and 450 ft. below the main outcrop. Development work on the sixth level was immediately begun and in three weeks the large orebody which we expected to encounter was found almost exactly where we had plotted it.

A new pump plant was of course immediately ordered, but this took time to install, and in the meantime it was most difficult to keep the water below the sixth level. A drain tunnel 866 ft. long was driven from the level of Pinal Creek to the Interloper shaft, tapping the latter at a depth of 155 ft., thus reducing the head on the pumps materially and increasing their capacity. In after years the problem of handling large quantities of water encountered was a most serious one, and this matter is very ably discussed in a paper by P. G. Beckett published in the *Transactions* of the American Institute of Mining Engineers September, 1916, about 30 years after the period mentioned above.

(To be concluded)

In an Early Issue

THE tallest concrete chimney in the Western hemisphere was erected during 1927 at the new copper smelter of the Horne Copper Corporation, in the Rouyn district in northwestern Quebec. It is 422 ft. 6 in. from the base to the top of the shaft; and the inside diameter at the top is 13 ft. 6 in. The details of the design construction of the stack are described in a well-illustrated article by the engineer who had supervision of the work.

Preliminary Considerations in the Development of Metallurgical Plants

By H. M. LEWERS

Mill Superintendent, Tonopah Belmont Development Company, Palo Verde, Arizona

PROBABLY the most vital decision to be made in the development of a new mining enterprise refers to the building of a mill or ore treatment. Many mines today operating successfully and profitably have been lost to original owners who exhausted their finances in building a plant before mine development or other conditions warranted such a step.

Metallurgy is considered an exact science; but, to judge from the number of abandoned plants scattered throughout the country, it would appear that this statement was open to question. An analysis of metallurgical failures discloses, in almost every instance, that the causes included overestimation of the amount and value of the ore to be treated; underestimation of the cost of mining, treatment, and marketing products; lack of sufficient finances; adoption of unsuitable metallurgical treatment; underestimation of cost of building the plant and placing it in operation; and inefficient management.

No general rules can be laid down as to the proper procedure of developing, estimating, planning, building, or operation of a plant; each is an individual problem that requires systematic study and co-ordination of all the factors and conditions involved before an estimate of cost or economic result can be made with reasonable accuracy. General figures for estimating are usually misleading; and published costs in handbooks and textbooks refer mainly to pre-war conditions. A comparison of costs of labor, machinery, and building material before the war and at the present time shows a marked advance in each item; $1.47 must be expended to procure what could be obtained for $1 before the war.

THE most important factor on which the ultimate success of a metallurgical plant depends is the actual grade of ore that can be delivered to the plant on a daily tonnage basis. More failures have been registered by overestimating this than by any other cause. The conventional methods of estimating developed ore are by cross-section sampling and measurement of the orebodies. A dilution from wall rock always occurs in mining the ore, and the ultimate result is a corresponding larger tonnage of lower-grade ore than would be indicated by sample maps.

It is always advisable to break under proposed mining conditions 100 tons or more of ore from several places along the developed orebodies, that represent average conditions and metal content, and ship to a mill, sampling plant, or smelter. The value of the ore so determined should be checked against the value of the cut samples from where the ore was taken and a dilution factor determined. The final 1,000-lb. cut, or more if deemed necessary, should be reserved for the development of the metallurgical process, and used as a basis for subsequent calculations.

In the selection of a stoping method, careful consideration should be given to the requirements of the plant. If the treatment costs are high, selective mining would be justified in most instances, and the extra mining costs per ton would be more than compensated in the final operating returns.

SMALL variations in the value of the ore result in much larger variations in net operating returns; and, to maintain the same grade of product, recoveries are invariably lower on low-grade than on higher-grade ore. Outlining a hypothetical case better to illustrate this, I will assume the following conditions: On sampling and measuring the developed ore in a mine by conventional methods, estimates gave 100,000 tons of ore having an assay value of 10 oz. silver and 10 per cent lead. Metallurgical tests made on these samples gave 85 per cent recovery of both metals in a concentrate assaying 50 oz. silver and 50 per cent lead, with a ratio of concentration of 5.88 to 1; or, on 100-ton basis, 17 tons of concentrate would be produced daily of the above grade. Market price of silver is taken at 50c. per ounce; lead 8c. per pound. Smelter payments and deductions are as follows: Payment for 95 per cent of the silver at market; on lead, 1½ per cent deducted from wet-assay value, payment for 90 per cent of the remainder at market, less 1½c. per pound. Smelting charges, $5; hauling to railroad, $5; freight to smelter, $7.50 per ton.

50 oz. silver—95 per cent @ 50c. per ounce	$23.75
50 per cent lead, less 1½ per cent—48.5 per cent—90 per cent of 970 lb. @ (8—1½c.)	56.74
Total	$80.49
Less hauling, freight and smelter charges	17.50
Balance	$62.99
Net returns of 17 tons concentrate (17x$62.99)	$1,071.00
Net returns per ton of ore	$10.71
Cost of mining and milling	6.00
Net profit per ton	$4.71

To treat this ore, a plant of 100 tons' daily capacity was built at a cost of $100,000. On completion of the plant it was found that, owing to dilution with waste or other causes, the average grade of ore that could be maintained was 6 oz. silver and 6 per cent lead, with a cor-

responding increase in tonnage to 166,000 tons. The recovery on this grade was 80 per cent of both metals in a concentrate assaying 50 oz. silver and 50 per cent lead, and resulting in a ratio of concentration of 10.41 to 1, and a daily tonnage of 9.6 tons of concentrate.

Net returns from 9.6 tons concentrate @ $62.99 per ton	$604.80
Net return per ton milled	6.048
Cost of mining and milling	6.00
Net profit per ton	0.048
In the first instance, 100,000 tons of ore having an assay value of 10 oz. of silver and 10 per cent lead would return a profit of	$471,000
Less cost of plant	100,000
Resulting in a net profit of	$371,000
In the second instance, 166,000 tons of ore having an assay value of 6 oz. of silver and 6 per cent lead would return a profit of	$7,968
Less cost of plant	100,000
Resulting in a net loss of	$92,032

It will be noted that in both instances the total ore treated contained exactly the same amount of both metals.

A drop of 1c. in the market price of lead would reduce the net profit in the first instance from $371,000 to $222,000, and in the second instance it would increase the net loss from $92,000 to $213,000.

IN THE foregoing illustration the critical grade, or the grade of ore necessary to pay all operating expenses, would be approximately 6 oz. silver and 6 per cent lead. By calculation it would be determined that, if the grade of ore treated could be increased to 7 oz. silver and 7 per cent lead, the yield would be sufficient to return the plant investment with interest on the capital involved in its outlay. On such slight margins often depends the success or the failure of a metallurgical enterprise. It is of the utmost importance that the tonnage and actual value of the ore that will be delivered to the plant be accurately predetermined, as this is the basis of all subsequent calculations.

The critical grade of the ore depends on the size of the plant and the character of the treatment required. Almost as many operators, mechanics, and technicians are needed successfully to operate a small plant as one of several times the capacity. The per-ton labor and administrative cost on a 50-ton plant may be three times the cost on a 200-ton plant.

Per-ton operating costs may be divided into administrative and overhead, labor, power, and supplies. Power costs are not subject to such wide variations, although the larger the tonnage and consumption, the higher the efficiency and lower unit rates. If necessary to develop the necessary power, the variation is much in favor of the larger installation, with either steam or oil engines as prime movers.

COST of supplies per ton treated is usually considerably lower with larger tonnage, owing to economies in the purchase and transportation of larger quantities of material. Operating costs vary according to the methods of treatment, the locality, and the cost of labor, freight and power. Relative costs on the basis of variable tonnage treated would be closely approximated in most cases by the following table, taking ore treatment on a 500-ton basis at $2 per ton:

Tons Per Day	Costs Per Ton
500	$2.00
250	2.75 to 3.25
100	3.25 to 3.75
50	3.75 to 5.00

Mining costs on the same basis show about the same relative variation. The economic success and advisability of building an ore-treatment plant depend on amount and value of ore developed; grade of ore that can be delivered to the plant on a daily tonnage basis; development of successful treatment; metallurgical recovery possible; variation of metallurgical recovery owing to variation in grade of ore; cost of marketing the product, and smelter and refinery deductions; establishment of a critical value for the ore on a basis of variable tonnage, and sufficient finances to build the plant and place it in operation.

Aside from the actual cost of the plant itself in estimating the finances required, the following items of cost should be considered: Equipment for delivering ore to plant; obtaining adequate water supply, storage, and distribution; disposal of tailing or residue; power installation and distribution; machine shop and equipment; assay office and laboratory; boarding, bunk and staff houses; office and supply warehouse and equipment; supplies that must be carried in stock; storage facilities for freight at rail siding; hauling freight; heating plant; installing adequate fire protection; taxes and insurance; building roads; yard equipment and tools; additional mine equipment necessary to maintain tonnage; and industrial insurance during construction.

After the size of the plant and the type of treatment have been decided upon, the per-ton cost of overhead and administration, power, labor, water, and supplies can be determined, from which the estimate of total operating cost can be made.

The preliminary work in the development of a metallurgical process is done in laboratory-size machines, and from this work a flow sheet is developed showing each step and machine necessary in the process, as well as the power, chemicals, reagents, labor, and material required. The larger ore-testing laboratories maintain large-scale testing plants, having a capacity of several tons per day and so arranged that almost any treatment or combination of treatments can be made and preliminary results checked on a working scale.

TEST results on ores involving concentration, flotation, and cyanidation can be duplicated in most instances in subsequent large-scale operation; but on ores whose treatment involves roasting and leaching, and where exact chemical and thermal control is necessary, the laboratory results are seldom attained in the regular operation. Some ores readily respond to treatment; others present great difficulties and sometimes necessitate several months or years of research work before a satisfactory treatment can be developed; others have baffled the efforts of the most skilled metallurgists in the world.

Samples taken from ore faces that have been opened up and exposed to the air for any considerable period may react to treatment in an entirely different manner than the unexposed bodies of the ore. It is almost impossible in making extended tests on an ore sample to prevent it from drying, and it is advisable to check the test results with a sample of ore from the mine that has been sealed in an air-tight receptacle and sent to the testing laboratory. At one of the large mines the ore is kept underground until the mill is ready to handle it, an exposure of 24 hours to the air having a deleterious effect.

MOST mine operators that have developed sufficient ore to warrant considering a treatment plant are besieged with offers and recommendations of new processes, machinery and ideas that, if adopted, would in most cases result in disaster. Any new process or machinery of possible merit is promptly given a thorough trial by the

larger companies; but it is a dangerous procedure to deviate from accepted and standard proven practice unless the substitute has been thoroughly tested.

The next step after the flow sheet has been definitely decided is the selection of machinery and the development of plans for the plant and complementary equipment, and detailed specifications and estimates of all material required. Contour maps and photographs of the available sites should be made, so that elevations and necessary excavating may be determined. Ground for the disposal of tailing or residue should be acquired and the law regarding its disposal investigated.

Several studies of plant layout may be necessary to determine the most advantageous setting and location. Consideration should be given in the plans for possible enlargement of operation, and this should be borne in mind in the selection of a site and in laying out buildings and equipment. A little forethought in this respect may save thousands of dollars later.

Material and machinery as received should be segregated and marked, and unloaded as near as possible where it is to be used, to avoid confusion and delay during the construction period. It is an advantage to arrange that the construction work be done during that part of the year when climatic conditions are most advantageous. In the north, where the winters are long, work should be started in the early spring; in the south, where winters are mild and summers very hot, the work should be started in the early fall. Men who follow construction work follow the swallow, and it is exceedingly difficult to organize an efficient crew during a season of the year when the climatic conditions are severe, whether from cold or excessive heat. Labor on construction may be increased 30 to 50 per cent because of bad weather.

ECONOMY and efficiency in construction work depend on the organization of an efficient crew under a capable superintendent, the adoption of a definite policy, thorough development of the plans and specifications of material, purchase of material in carload lots when possible, and proper co-ordination of the arrival of the machinery and material with the progress of the work.

The building of a metallurgical plant may be divided into the following phases: excavating; concrete construction and foundations; building construction; installation of machinery and pipe fitting; electrical installation and tank construction; each requiring different classes of labor, mechanics, tools, and equipment. Where speed is essential, to contract each phase of the work is often advisable. A large proportion of the skilled millwrights and mechanics who specialize in this class of work are tied up with contractors or construction companies. Often a contractor would have the work well under way before a company depending on the open labor market could assemble an efficient crew.

THE breaking in of a new plant usually requires 30 to 60 days or more, and this is a period of high operating costs, low tonnage, poor recoveries, and hard and discouraging work. Operators must be trained; machinery and details of the process must be co-ordinated, and considerable time is lost in making necessary changes and adjustments. Few of the successful plants in operation today were on a self-supporting basis during this period, and due consideration should be given in the development of the plans and estimates to this cost of placing the plant in successful operation, which may be from 5 to 20 per cent or more of the cost of the plant.

Innovations at the United Verde Mine

Blasting, Drilling, Ore Transportation, and Mining Methods All Show Improvement

By E. H. Robie
Associate Editor

(Third of a series, "Revisiting Arizona Mining Camps," continued from April 7 issue, p. 586)

I REGRETTED the absence of R. E. Tally, general manager of the United Verde Copper Company, at Jerome, but W. Val DeCamp, general superintendent, told me most interestingly of recent happenings and showed me the surface work which, in some respects, is unique. As most of my readers know, the United Verde orebody is an immense vertical mass of chalcopyrite and pyrite that has been on fire for years, making difficult the extraction of much of the ore in the mine. At present, 60 per cent of the ore produced comes from underground workings and 40 per cent from the open pit by which the ore remaining in the upper fire zones is being reclaimed.

An interesting innovation in blasting methods is being tried, which brings up a subject to which mine operators should give more attention. Formerly, when a considerable amount of ore was smelted directly in blast furnaces, a large amount of fine material was not always desirable, but when everything must be ground for concentration, mining and blasting methods should be selected which will reduce crushing and grinding costs. Furthermore, fine ore can often be handled more economically than large chunks. To secure maximum fine material, the United Verde has adopted a system of sectional loading of machine drill holes. In a 7-ft. vertical hole, for example, will be put a plug of powder, say three sticks of 50 per cent gelatin, 18 in. of sand tamping, and on top of that 18 in. of powder, Cordeau connecting the charges. By this method, the percentage of coarse material broken—that is, material 2 ft. or more in diameter requiring block-holing—has been reduced from 50 to 10 per cent. Experiments with a compressed-air tamping machine imported from Germany and used there in coal mines have also been favorable. This is merely a cylinder containing sand or other tamping material, which is expelled through an outlet tube, by compressed air, into the drill hole. By this method, a plug of sand may be built up in a drill hole, with an intervening air space between the powder and stemming. Thus is the force of the explosion lessened at the surface of immediate contact with the powder, but extended over the entire area of the hole below the sand plug.

Lack of suitable drilling machines adaptable to the hard, irony ore was formerly a hindrance that has now been overcome. Waugh No. 39 rotating stopers, with 1¼-in. hollow round steel, are used, though experiments are being conducted with Ingersoll-Rand and Sullivan rifle-bar drills of similar size.

With the finer material, scrapers are being used to advantage for moving the broken ore to the chutes. But a more novel method, at least in this country, is also being tried—namely, the use of shaking trays. Such devices have been used for some time at Rio Tinto, according to Mr. DeCamp, and also in South Africa, though at a 4 or 5 per cent incline. Here at Jerome they are set level in the stopes. The trays are 4 in. deep, 16

in. wide, and are set about 16 in. above the floor, the supports resembling small saw-horses. The trays are given a jerking motion by a compressed-air device, with a bump similar to that of a concentrating table, which shakes the ore along. Tray sections can be connected together easily by bolts, to a length of 30 to 60 ft., making fewer chutes necessary. Angles may also be negotiated, one tray delivering to another series going in a different direction, but with the same power impulse re-directed.

The electric welding of drill steel is another subject that is being given attention, two manufacturers now making equipment suitable for this purpose. Proper heat treatment of drill steel has long been an object of study at this mine, and foreign methods, including tempering in a salt bath, are being investigated. In addition, a Brinell machine is used for establishing the proper hardness for drill steel shanks; this, combined with the use of line oilers, has materially reduced the cost of drill repairs.

Level and vertical or intermediate pillars are largely extracted by top slicing. Of the ore mined underground, 29 per cent is extracted by top slicing—largely on the pillars; 50 per cent by horizontal cut-and-fill; 14 per cent by square-set; and the other 7 per cent by miscellaneous methods. Two sections are experimenting with incline square-sets, and two with incline cut-and-fill.

The new methods mentioned are expected to reduce stoping costs 25 per cent, or from $1 to 75c. per ton.

Three benches are being worked in the open pit. Bucyrus electric shovels, full-revolving type mounted on caterpillar tractors, deliver the various grades of ore and waste to Moreland six-wheel trucks, which transport the ore to one of several raises which have been carried up from the 1,000 level. Here, the body of the truck revolves and dumps, the fall through the more or less crooked raise breaking the ore considerably. Owing to its heat and contained sulphates, some of the ore would solidify in 24 hours, so the ore pockets at the bottom are drawn fairly clean. As these shovels are operating in the old partly stoped fire zone, several different classes of material are handled, which, by the methods used, can be kept segregated. Each raise is reserved for a particular kind of ore.

When this work in the pit was started, sulphur gases from the burning ore gave the workmen more than a taste of the hereafter. Often, work was virtually impossible. This condition has been largely remedied by sinking churn-drill holes 20 or 30 ft. into the hottest sections, and pumping in flotation tailing, thus sealing the fissures through which the smoke escapes. For this purpose tailing is brought up to the hill in tank cars, agitated in a tank, and pumped to the point desired. Much of this is, however, too fine for best results, so a crusher and ball mill will be installed in the pit to grind low-grade ore to 15 mesh, which size is expected to be ideal for the purpose, as well as being more desirable from the metallurgical standpoint when afterward recovered.

Blasting the hot ore offers difficulties, as may be imagined, the temperature varying from 150 to 300 deg. F. Churn drills are used because of the greater safety of blasting in the large hole, which may be more easily cooled, temporarily, by water. An electric type, made by the Armstrong Manufacturing Company, of Waterloo, Iowa, has been adopted, and it is said that they save $500 a month each over churn drills operated by steam. Wire-rope economy is an important item.

For blasting churn-drill holes, as much as two cases of stick powder are placed in a galvanized sheet-iron tube, 4 in. in diameter, lined with asbestos. This torpedo is dropped in the hole and fired as quickly as possible—inside of four or five minutes. For the small jackhammer drill holes used for control work, the powder is wrapped in paper tubes with walls $\frac{1}{8}$ in. thick.

A total of 1,500 to 2,000 tons a day is now being broken in the pit. Present methods will be continued down to the 500 level, below which the pit would become too small for practical operation or the side walls too steep for safety.

The United Verde, with its varied operations and its excellent reputation, appears to be quite a magnet for young mining graduates, some of whom are taken on every year. They start as muckers, gradually advancing to timbermen, jigger bosses, and shift bosses, being given as varied work as possible. As this policy has been in force for some time, the personnel is well provided with competent men to fill any vacancies, and Mr. DeCamp told me that no one in any class of employees higher than miners had been employed for five years. In fact, the company has more men fitted for good jobs than it has places for and is sometimes successful in finding places for worthy men with other companies. Conditions are made as attractive as possible, and there is no difficulty in holding trained men. A graduate, after five years of experience, will receive about $250 a month on the average. Three years ago, 2,000 men were employed in the mine, steam-shovel, and mechanical operations. This has now decreased to 1,200, largely owing to the completion of stripping operations.

(To be continued)

A Clean-up Experience

By D. H. Norcross
Salmo, B. C.

WHILE operating an old gold property under lease several years ago, we discovered an accumulation of sand under the battery floors in the mill. Part of this was leakage from a mortar which had been cracked by dynamite exploding under the stamps and the rest from overflows. After sampling and assaying the material we decided to run it through the mill, as it was of commercial value. It was frozen solid. However, this proved an aid rather than a handicap. Being in solid chunks when fed into the mortar, it prevented the stamps from cutting through the sand and pounding the die. Thus we were able to treat all of it without breakage of stamps.

The material seemed to be rich and soon made a good bed of amalgam on the plates. We noticed it had a rather leaden color, but this caused no doubt in our minds as to its value. When cleaning up we obtained about twice as much amalgam from the clean-up barrel as from the plates, and were somewhat surprised by the way in which it seemed to cling to the iron and steel, of which there was a large amount. Upon opening the retort we noticed that a portion of the sponge had melted and was still in a molten state in the bottom of the retort. We poured out all that would run. Upon examination it appeared to be lead or babbitt. The unmelted portion was fluxed and melted down and gave a base bar of about 650 fine. A qualitative analysis of the other portion soon told us it was about one-third gold, the remainder being lead, presumably from babbitt. This was fluxed, oxidizing as much as possible of the lead, and a bar of 450 fine was obtained.

Why Let Mine Timber Decay?—I

Preservative Treatment

and Its

Economy

USE of preservatives for wood dates back to ancient times. Impetus was given to the art about 1800 A.D., when England was engaged in a series of wars, success in which was endangered by the tremendous demands of the navy on the timber supply. It was then learned that poisons inhibited decay, and the use of the salts of metals was proposed as a remedy. The first real progress in wood preservation was made approximately in 1830. At that time three methods of treating timber were invented that are in use today—namely, Kyanizing, the Burnett and the Bethell processes.

Left: untreated timber which has become rotten at the base in four years' service. Right: Western yellow pine which has decayed in one year. In both instances the timber was in return airways where conditions were favorable for decay.

The foregoing bit of history is from Bulletin 33, entitled "Methods and Costs of Treating Mine Timber," just published under the joint auspices of Carnegie Institute of Technology, the U. S. Bureau of Mines, and certain mining and metallurgical advisory boards. In this bulletin, the authors, L. D. Tracy and N. A. Tolch, present data secured by them in the course of an investigation of existing practice as to preserving mine timber, together with their findings. The gist of the contents is given in the following pages.

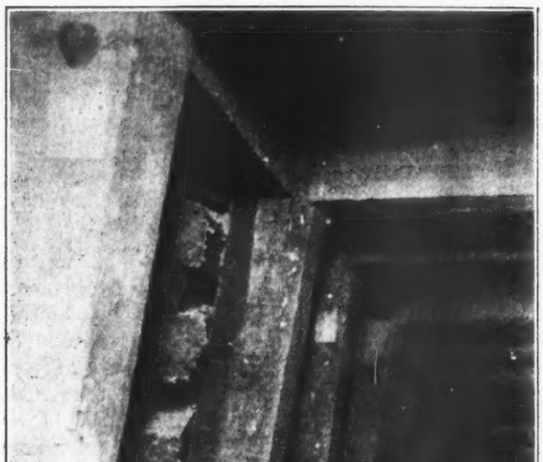
Largely because of the interest taken by American railroads, the wood-treating industry was firmly established by 1880 and since then has rapidly grown. In 1926, a total of 289,322,080 cu.ft. of timber was treated. Of this amount, 187,963,614 cu.ft. was railroad crossties. Poles ranked second, with 49,511,089 cu.ft.; construction timbers third, with 31,147,287; piling fourth, with 12,420,977; and the remainder of 8,279,113 cu.ft. consisted of wood blocks, cross-arms, and miscellaneous material. It can readily be seen that the industry is no longer an experiment; it is a firmly established business based upon sound principles.

The findings of the investigators may be summarized as follows:

1. Decay of Timber—Decay of timber is the result of the destruction of the structure of the wood by fungi. This is accomplished by the fungi working into the timber and dissolving its vegetable substances by means of the enzymes which they produce. Fungi are propagated by spores, given off by other existing fungi, carried on the ventilating current, and finally deposited on the surface of the sound timbers, where they germinate and develop.

The two fundamental factors contributory to rapid decay are temperature and moisture. The most favorable temperature for the development of fungi ranges from 75 to 90 deg. F., with a supply of moisture from the atmosphere itself or from other sources which may keep the wood damp but not saturated.

Ventilation is an exceedingly important influence in



Timbers treated with a preservative. They have been in this location since 1922

mine-timber decay. Readjustment of ventilating systems should be studied to ascertain if more fresh air can be circulated among the more heavily timbered parts of the mines, so that, if possible, the rate of decay may be reduced.

When mining operations are to be suspended for a year or more, the conclusion that money might be saved by stopping the fans and saving the expense of power should not be hastily reached. The cost of replacing decayed timber, of clearing up roof falls resulting from the failure of timber weakened by decay, and of the possible loss of coal, or ore, in pillars and ribs because of cave-ins owing to rotten timber, should be balanced against the proposed gain obtained by cutting off the cost of running the fans.

2. Requirements for Wood Preservatives—Two fundamental requirements may be set down for any effective wood preservative: (a)it must be toxic to fungi, and (b) it must remain in the wood indefinitely. Other limiting factors in the suitability of a preservative are (a) cost and supply; (b) ease of injection into wood; (c) ease of handling; (d) corrosion of metals; (e) the question of fire hazards; and (f) the possibility of injury to workmen coming in contact either directly or indirectly with the preservative.

3. Problem of Injecting Preservatives — Different species of wood vary widely as to the ease with which they may be injected with preservative. Of two species of equal characteristics in respect to cost and supply, strength, and resistance to wear, the one more amenable to treatment should be selected.

4. Preparation of Timber for Treatment and Handling Thereafter—Timber must be prepared for treatment by peeling and seasoning. Bark is almost impervious to preservatives, and green timbers are resistant to injection of preservatives.

After treatment, the timber must not be cut or the preservative seal broken. Cutting and framing must be done prior to treatment and ties must not be adzed or notched after they have been treated. The underlying principle in the use of preservatives is to create a toxic seal entirely around the timber, which by poisoning its food supply will prevent the growth of fungi. If this seal is broken by cutting or bruising or by natural causes such as checking and cracking, the protective effect of the timber treatment will be lessened if not lost.

Treated timber apparently is handled carelessly at many mines, which probably accounts for its many alleged failures. Mining companies spend money for timber preservation and then neglect to impress upon their men how necessary it is to keep the preservative seal intact. Any exposed untreated surface renders useless all attempt at timber preservation unless the preservative has been completely absorbed throughout the timber.

Timber multilated in the manner described, may, when placed in a mine, be considered by the officials as treated timber, inasmuch as that was what was bought and paid for. When this timber begins to decay, because of the cutting and consequential breaking of the preservative seal, the natural impulse is to consider the treatment itself as ineffective; whereas, in reality, the treatment has been efficient, but has been nullified by subsequent cutting and trimming of the timber.

5. Internal Versus External Treatment — Although dipping and brush treatments will prolong the life of timber, thorough hot- and cold-bath and pressure treatments are more efficient and will show greater economy where long life is desired and where the conditions of service are severe.

6. Economy of Treatment Proved by Railroads—The economy of using treated material has been demonstrated by the railroads. Although no direct comparison is to be made between the conditions of service of timber used by the railroads and those of the timber used by mines, certain factors are favorable for decay in both cases. The economy in the use of treated timber by railroads should be a criterion for the mining industry.

7. What Timbers Should Be Treated—Only permanent or semi-permanent timbers should be treated. Shaft and slope timbers, drift sets, mine ties, timbering in raises and winzes, ore pockets and bins, head frames, railroad ties, and poles are all treatable material, whereas stope timbers, (including stulls, square sets, chutes, cribbing and manways) are more temporary in nature and in most cases need not be considered for treatment.

8. Value of Treated Mine Timbers—A system of

service records should be devised for treated mine timber to show the type of treatment, approximate date of placement, position in the mine, and condition of the timbers. This can best be accomplished by nailing a metal tag on the timbers when they are placed in the mine, with subsequent inspections at suitable intervals to determine the condition of the material. Such tagging is done by Anaconda Copper and Miami Copper.

9. Value of Treated Building Lumber — Company houses, stores, storehouses, and other surface buildings when built of wood and in a climate favorable to decay should have their sills, ground-floor joists, and other lumber near the ground treated with preservative. In fact, it may be economical to treat all exposed timbers.

10. Cost of Treating Timbers—The following treatment costs expressed in terms of cents per cubic foot are average values obtained in this field study: (a) Dipping varied from 7 to 18c. and will average about 12c.; (b) a hot- and cold-bath treatment with zinc chloride about 11c.; (c) a Burnett pressure treatment with zinc chloride about 11c.; (d) a Rueping treatment with creosote about 22c. and (e) a Bethell full-cell treatment from 11 to 35c.

11. Cost of Pressure-Treatment Plant—The cost of new plants ranges from $15,000 to $40,000, depending on capacity and equipment. One plant in Arizona, apparently efficient, was built at a cost of $6,300. This low cost is attributed to the fact that the material used in its construction was largely salvaged from discarded equipment used about the mine. Similar material constituted an open-tank plant in Michigan and cost $1,500.

12. Life of Treated Mine Timber—The life of mine timber can be increased indefinitely by a thorough preservative treatment, provided the timbers are not broken by pressure or destroyed by mechanical wear. The best record of service consisted of shaft timbers given a pressure treatment with creosote; these have been in service eighteen years and are still in a sound condition. Other installations of treated mine timber show a life of fifteen to eighteen years, with the material not yet tested to failure by decay. On account of variable local conditions in mines, the life of timber is highly variable. However, according to service records, a thorough preservative treatment by hot- and cold-bath or pressure processes will ordinarily increase the life from two to four times that of the natural life untreated.

13. Saving of Treated Over Untreated Timber—In all cases where it was possible to make a comparison the use of treated material was apparently an economy. An annual saving of $3.68 for each set of gangway timbers was shown at one mine by the use of treated material, and $2.75 per set of drift timber and 25c. per tie at other mines.

14. Use of Waste Timber—A well-equipped framing mill and standardized sizes of timber are of assistance in lessening the cost of timber; this is shown in a case cited, where the cost of operating the mill was carried by the working up of the waste into blocks and wedges. It also saved the labor costs of cutting and framing the timber by hand inside the mine.

15. Apparent Reasons for Unsuccessful Timber Treatment—Instances have been reported in which mining companies have tried treated timber and have had indifferent success, if not absolute failure. The reason for this is readily apparent: It seems to be the custom at these mines to turn the work of treating timber over to a yard foreman or in some cases to an ordinary laborer, without adequate supervision, who has neither interest in or knowledge of the subject. As a result, perhaps green timber is treated, the periods and time of treatment are irregular, no regular analysis of the preservatives is made or even an unsuitable preservative may be used.

It may happen that a standard and time-tried preservative will be abandoned for some particular chemical because of interest or influence; even a standard and known preservative will be sacrificed to save a few cents per pound in favor of an unknown article. It cannot be emphasized too strongly that to obtain successful results from treated timber, the timber must first be properly seasoned and then scientifically treated with the right kind of preservative under intelligent supervision. If a mining company is not prepared to do this, it must not expect good results from timber treatment.

What Preservatives Are Used

The following discussion on preservatives by G. M. Hunt should be carefully read.

"Many preservatives are sold under trade names of various kinds. Part of these are ordinary coal-tar creosote or coal-tar creosote that has been modified somewhat by taking out some of the solid ingredients. A number have had the lighter fractions removed, making them higher boiling than the ordinary run of creosote. In the main, preservatives thus derived from coal-tar creosote are good preservatives and may be used with assurance. Whether it is economical to use them depends upon their cost as compared to that of coal-tar creosote or zinc chloride.

"Other proprietary preservatives contain wood-tar products or other oils. The effectiveness of these is not well established, but doubtless some of them have value. A third group comprises preservatives made of water-soluble salts in various mixtures. Whether or not these are good depends upon their components. Before a purchaser buys a preservative of this kind he should insist upon knowing the ingredients and their proportions.

"It is unnecessary and unwise to invest money in preservatives where formulas are secret.

"The literature exploiting some of the proprietary preservatives not infrequently contains extravagant claims as to properties and effectiveness. Obviously, such claims should be greatly discounted.

"As a general rule it may be said that very few, if any, proprietary preservatives are better or more generally satisfactory in their respective classes than straight coal-tar creosote and zinc chloride."

For guidance in purchasing preservatives, the appendix of the Bulletin gives specifications which have been adopted as standard by the American Wood Preservers' Association.

How Big a Plant Is Necessary

16. Capacity of Treatment Plant—In planning a pressure plant for treating mine timber, the future demand should be carefully considered. It is possible that a group of mines in which treated timber is being newly installed will create a greater demand at the beginning of the operation than it will at a later period. This results from the possible replacements, or the entire retimbering of an entry or drift with treated timber, together with the normal demand for treated timber in the ground being newly opened. As the replacement of old untreated timber approaches completion, the load on the treatment plant will decrease until it reaches its regular demand of supplying treated timber for advance workings only. Therefore, perhaps the operation of the plant should be continuous at first and gradually decreased until one eight-hour shift will suffice to treat the normal output.

17. Grades of Timber That Should Be Treated and Used—As a final conclusion it may be stated that the

fundamental principle of mine timber treatment is to treat the inferior and cheaper grades of timber and to use them wherever possible as a substitute for the more costly and more enduring grades, which may have to be imported from other states. Such timbers, when properly treated, will last as long as the more expensive species, provided they can also withstand the mechanical wear. It may be advantageous to use a combination of good and inferior grades when mechanical strength is needed. For example: treated posts of soft wood and a treated cap of hardwood which will be required to carry a heavy roof load.

In localities where cheap wood can be found near a mine, not only may the maintenance cost be reduced by treating the timber, but the cost of the timber plus the cost of treatment may be less than the cost of imported timber untreated.

(To be concluded)

Antamokite—A New Telluride Discovered in the Philippines

A SAMPLE of gold telluride ore found in the Philippines and reported to run as high as $20,000 a ton has recently been investigated by Antonio D. Alvir, geologist of the Bureau of Science, Manila, Philippine Islands. The result of his mineralogical study as reported to J. S. Colbath, of the Benguet Consolidated Mining Company, follows:

Megascopically, the ore is a fissure filling in andesite of vuggy quartz impregnated with chalcopyrite and tetrahedrite which occur either alone or as a mixture. Pyrite is also present in small quantities, generally mixed with the tetrahedrite. Under the microscope, the following minerals were recognized. They are given in the order of deposition:

1. Prismatic quartz crystals.
2. Pyrite (in minor amounts).
3. Tetrahedrite (cut by calaverite).
4. Calaverite (silver-free).
5. Antamokite (new mineral—gold-silver telluride).
6. Tetrahedrite (inclosing calaverite and antamokite).
7. Chalcopyrite (generally replacing tetrahedrite).
8. Quartz.

Considerable trouble was met in the attempt to identify one mineral, because its microchemical reactions were very different from any heretofore known. Its microchemical reactions follow:

HNO_3—Slowly tarnishes slightly dark and rubs nearly clean. Upon long interaction with the acid it develops pits and after a little grinding and polishing it shows a pitted surface.

HCl—Negative (may tarnish very slightly).

KCN—Negative.

$FeCl_3$—Immediately tarnishes to iridescence and remains so after rubbing.

$HgCl_2$—Slowly tarnishes yellow and rubs faint yellow.

KOH—Negative.

The hardness is low, probably between 2 and 3. The color is bluish-grayish white and the color of the powder is dark gray. This mineral occurs in tiny portions, almost always associated with the calaverite; consequently it was difficult to isolate it, but a sufficient sample was obtained to secure a qualitative analysis showing gold, a little silver, and tellurium. No lead, antimony, or copper was found. This mineral, which in all probability is a new species, is hereby named Antamokite, after Antamok, the town near where it was found.

The ore deposit, judging from the sample submitted, belongs to that class of young gold-silver lodes to which the Cripple Creek deposits belong. They are generally quartzose fissure fillings, full of vugs, with tellurides of gold and silver, tetrahedrite, and the common sulphides as ore minerals. These were precipitated from hot ascending solutions connected with the latest intrusions. The country rock is generally andesite.

Ores of this class generally do not persist to depths greater than 500 to 700 meters. It has been observed that there is an impoverishment as the zone of primary minerals is attained. It is also known, as at Cripple Creek, that there are no signs of secondary enrichment. In the zone of oxidation, metallic gold should be found derived from the oxidation of the tellurium in the gold tellurides.

Quartz in perfect prismatic crystals imbedded in some of the ore minerals was the first mineral to be deposited. The little pyrite found and the tetrahedrite were next, although some tetrahedrite may have come later. This tetrahedrite is destitute of silver, but is auriferous. Then the calaverite and the antamokite were deposited contemporaneously, generally associated with the tetrahedrite. In places the two tellurides of gold above mentioned cut through the tetrahedrite, and in other parts of the deposit they may be included in the tetrahedrite. This is why it is probable that tetrahedrite was deposited at different times. Chalcopyrite, although some of it may be primary, occurs mostly as a replacement of the tetrahedrite. Finally more quartz was deposited. Tetrahedrite and chalcopyrite are the most abundant metallic minerals.

This ore carries much gold, very little silver, and a considerable amount of copper in the form of tetrahedrite and chalcopyrite.

Speiss as a Collector of Platinum

AT THE Chemical, Metallurgical and Mining Society's meeting at Johannesburg on Feb. 18, H. Rusden and I. Henderson stated that were it not for its remarkable affinity for the metals of the platinum group, speiss could not be considered a desirable product of furnace operations, as its presence tended to form obstructions in the crucible; but its marvelous property of acting as a collector for platinum metals at once raises it to a position of great importance and intense interest. On an experimental scale at the Witwatersrand Co-operative Smelting Works, a speiss had been made containing 6.9 per cent, equal to 2,012 oz. of platinum metals per ton. Before 1923, no attempts had been made to dispose of any speiss produced at the smelting works; but since that date many lots (of one ton each) have been dispatched overseas.

There is the question, the authors concluded, if the peculiar property of speiss can be made available for collecting platinum-group metals from concentrates on the Transvaal platinum fields. They think it is certain that, provided a perfectly fluid melt can be obtained, the presence of a small amount of speiss would collect almost all the platinum metals from a considerable quantity of concentrates. Before this can be accomplished, however, much further research must be carried out.

USEFUL OPERATING IDEAS

Determining Composition by Specific Gravity

By L. O. Howard
Pullman, Wash.

IN CERTAIN experimental work involving mixtures of two solid substances, it is often possible to simplify determinations of compositions by means of specific-gravity tests instead of more difficult and time-consuming chemical analyses. For instance, in ore dressing, particularly in experimental studies of its laws and operation, many tests are made using pure galena and pure quartz. Examples are investigations of the fundamentals of tabling, jigging, classification, both free and hindered settling and certain flotation phenomena. In these experiments a rapid method of determining compositions of products is desirable.

Assuming that specific gravities of the quartz and galena used have been determined, and that it is desired to know the percentage of galena in, say, a given concentrate, the specific gravity can usually be determined in a few moments by water-displacement measurements. A simple formula can be derived for determining the percentage, either by weight or volume.

Let A equal the unit weight of a solid having a specific gravity of S_A, and B the unit weight of a solid specific gravity S_B, where S_A is less than S_B. The respective volumes of these solids would be $\frac{A}{S_A}$ and $\frac{B}{S_B}$. If we make a mixture of these solids, its volume would be $\frac{A}{S_A} + \frac{B}{S_B}$, its weight, $A + B$, and its specific gravity, S, equals $\frac{\text{Weight}}{\text{Volume}}$, or

$$S = \frac{A+B}{\frac{A}{S_A}+\frac{B}{S_B}} = \frac{A+B}{\frac{A S_B + B S_A}{S_A S_B}} = \frac{(A+B)S_A S_B}{A S_B + B S_A} \quad (1)$$

Clearing, $A(S S_B - S_A S_B) = B(S_A S_B - S S_A)$.

Then, $\frac{A}{B} = \frac{S_A S_B - S S_A}{S S_B - S_A S_B}$ and

$$\frac{A}{A+B} = \frac{(S_A S_B - S S_A)}{(S_A S_B - S S_A) + (S S_B - S_A S_B)} = \frac{S_A S_B - S S_A}{S S_B - S S_A} \text{ or}$$

$$\text{Per cent, by weight, of lighter mineral} = \frac{S_A(S_B - S)}{S(S_B - S_A)}.$$

Likewise, the percentage by weight of the heavier mineral may be calculated from $\frac{B}{A+B}$ to be $\frac{S_B(S - S_A)}{S(S_B - S_A)}$.

Applying these formulas to a mixture of quartz and galena, the percentage of galena by weight would be

$$\frac{\text{sp.gr. galena (sp.gr. mixture} - \text{sp.gr. quartz)}}{\text{sp.gr. mixture (sp.gr. galena} - \text{sp.gr. quartz)}},$$

and of quartz,

$$\frac{\text{sp.gr. quartz (sp.gr. galena} - \text{sp.gr. mixture)}}{\text{sp.gr. mixture (sp.gr. galena} - \text{sp.gr. quartz)}}.$$

Dealing with substances as different in specific gravity as quartz and galena, the accuracy of the method is high, and much time is saved in getting results. It is applicable, also, to the determination of the composition of certain alloys, and particularly so where gravities are far apart and the metals are but slightly soluble in each other in the solid state. For instance, I recently used the method to check the compositions of a series of lead-antimony alloys, made from mixing known weights of lead and antimony. The accompanying table shows the closeness of the calculated results to the assumed.

Composition of Lead-Antimony Alloys Calculated From Specific Gravity Determinations

Specific Gravity of Alloy	Percentage of Antimony — By Calculation from Specific Gravity	Percentage of Antimony — By Assumption from Weights Taken
11.345		0
10.976	4.68	5
10.443	12.04	12.5
9.346	29.80	30
8.353	49.90	50
7.556	69.85	70
7.091	83.54	85
6.604		100

Inasmuch as a possible slight volatilization of antimony took place during melting and casting, the method may be accepted as giving close results under conditions similar to the above. In the case of the sample supposed to contain 85 per cent antimony, the specific gravity was low, owing to a porous cast. In the above work the time saved over that necessary to make chemical analyses for antimony was large.

Many other applications of these formulas are possible, such as for the estimation of gold in quartz nuggets, or of scheelite in quartz or calcite, or of cassiterite in a one-gangue concentrate—all instances where the chemical analyses are tedious and incidentally destroy the specimen.

If A and B are taken as unit volumes instead of unit weights, percentages by volume can be expressed by the formulas,

$$\frac{S_B - S}{S_B - S_A} \text{ and } \frac{S - S_A}{S_B - S_A} \text{ for}$$

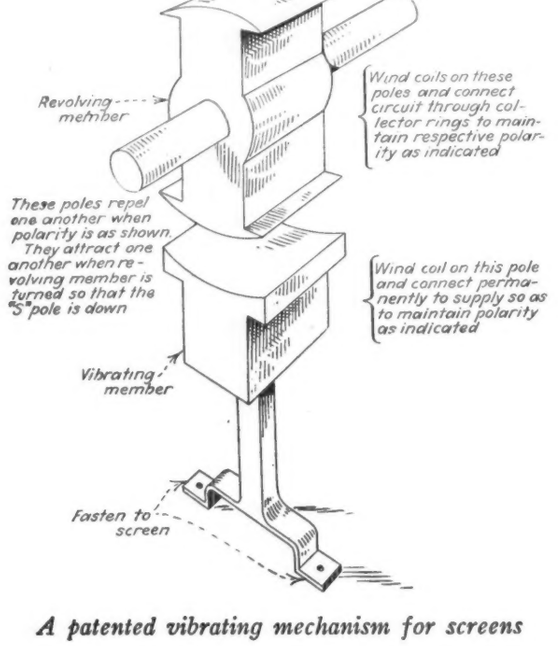
solids of lesser and greater gravity respectively, where A represents unit volumes of the solid of lesser gravity.

Acknowledgment is made of the assistance of Prof. C. F. Bowles, of the mathematics department of the South Dakota State School of Mines, in working out, comparing, and testing mathematically possible methods of quick analysis.

Vibrating Mechanism for Screen

By Edward T. Keenan

THE drawing below illustrates the principle of an electric vibrating mechanism for vibrating screens or any other shaking machinery. As a screen vibrator it is simple to understand and to manufacture. The strength of the vibrations is governed by varying the


Revolving member
Wind coils on these poles and connect circuit through collector rings to maintain respective polarity as indicated
These poles repel one another when polarity is as shown. They attract one another when revolving member is turned so that the "S" pole is down
Wind coil on this pole and connect permanently to supply so as to maintain polarity as indicated
Vibrating member
Fasten to screen

A patented vibrating mechanism for screens

strength of the magnetic poles. The number of vibrations is governed by the number of revolutions of the revolving member.

No special or elaborate electrical generating apparatus is necessary. The device can be used with either a.c. or d.c. current. Where no current is available, a simple generator can be built in as part of the vibrator. The device is covered by basic patent.

Rapid Method for Determining Copper in Copper Concentrates

A MODIFICATION of the sodium fluoride-acetate method for determining copper is described by S. V. Crompton in *The Chemist-Analyst* as being useful where speed and a reasonable degree of accuracy are essential, as in the case of shift samples and test work. The method takes about twenty minutes, and with care gives consistent results within 0.25 per cent and closer. It is described as follows:

Decompose 0.25 or 0.50 grams of ore with as little nitric-chlorate mixture as possible. Dilute with about 25 c.c. water and add ammonium hydrate until ferric hydroxide persists on shaking, but not enough to make the solution alkaline. Add 3 c.c. acetic acid, then 2 grams of sodium fluoride, and shake until all the iron is in solution. Cool and titrate with thiosulphate as in the usual iodide method. If the manipulation is carried out properly the end point will not return. The thiosulphate should be standardized by running an accurately assayed sample through the same procedure.

Measurement of Low Air Velocities

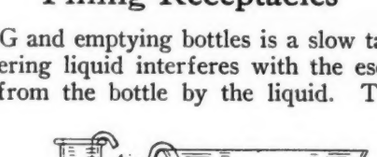
IN THE January *Bulletin* of the Institution of Mining and Metallurgy, J. P. Rees calls attention to the need for better methods of measuring low air velocities in mines. He states that the smoke or dust-cloud method is unsatisfactory. Various instruments for this service are described. The torsion anemometer consists of a thin rectangular aluminum vane suspended vertically from a horizontal wire. The twist or torsion necessary to bring the vane into a vertical position when it has been deflected by the air current is a measure of the velocity.

The instrument is mounted upon a tripod. A small telescope is used to determine the position of the vane. A low-speed vane anemometer (Ower) is also described, as is the hot-wire anemometer (McGregor-Morris), which makes use of the varying resistance of an electric circuit when exposed to moving air. The last-named anemometer registers velocities up to 200 ft. per minute. The kata-thermometer is also used for measuring low air velocities.

Respecting the calibration studies made upon the various instruments, Rees states that the Ower anemometer and the McGregor-Morris hot-wire anemometer read higher than the torsion anemometer at low velocities. The hot-wire anemometer does not agree with the Ower anemometer, but the discrepancy is not serious except at very low velocities.

Filling Receptacles

FILLING and emptying bottles is a slow task because the entering liquid interferes with the escape of air displaced from the bottle by the liquid. This trouble



The tube shown facilitates filling by letting air escape

can be eliminated by using a small tube in the bottle or funnel, as shown in the accompanying illustration.

THE electricity and compressed air used on the great Witwatersrand gold fields in South Africa are produced at a steam-generation plant boasting of the lowest costs in the world. The current is sent from Witbank to Johannesburg at 132,000 volts, over aluminum cables. Substitution of machinery for inefficient native labor is the trend of the times. The Witbank power plant will be described in a forthcoming issue by Mr. John Watson, of Johannesburg.

COMMENT AND CRITICISM

Canada's Future in Copper

THE EDITOR:

Sir—That within ten years Canada will become the world's third largest producer of copper, being then surpassed in this field only by the United States and Chile, seems to me a reasonable prediction to make from data assembled in the course of a study of this subject. Although Canada now produces only about 5 per cent of the world's output of copper, an enormous increase in production will be possible by the development of the newer fields just now coming to the front, such as the Rouyn district in Quebec, the Frood mine area near Sudbury, in Ontario, and the several copper properties in Manitoba represented in the public mind by such names as Flin Flon, Mandy, and Sherritt-Gordon.

INCREASING DEMAND FOR COPPER

Copper is a world metal, and for this reason Canada's future as a copper producer is likely to be governed to a great extent by the world's markets for copper. Various factors tend to influence the trend in the production of copper. No diminution in the per capita consumption seems likely, but rather there is the probability of a gradual increase in use. Electrification of industries, from an increasing supply of cheap electric power, would mean wider markets for copper for the construction of transmission lines and the building of dynamos and motors. Cheaper copper would find more extensive use as a building material. Electric refrigeration and the greater use of electric devices in the home as well as in industry indicate a growing demand for copper. In combination with other elements, copper is being used for the manufacture of a variety of bronzes suitable for many special purposes. "Copper for permanence" is a slogan that is likely to promote the consumption of this metal. Per capita use of copper in the United States grew from 8.22 lb. in 1913 to 15.54 lb. in 1926. A similar growth in the use of this metal has not yet been observed in European countries. In most parts of Asia and Africa, copper is used only for coinage and ornaments, but it is not improbable that the influence of Western civilization will be reflected in the further use of copper in these countries. Between 1897 and 1912 the world's consumption of copper increased 139 per cent.

At present the United States is the world's principal producer of copper, and also the chief user of this metal. United States and British interests control practically the whole of the world's supply. Chile ranks second as a producer, with wonderful deposits of easily won metal. Africa has attained third place, and the Belgian Congo is one of the world's great question marks in copper. Then Canada, Mexico, Peru, Spain and Portugal, and Japan come together in a group where no one country so far has seemed to have much advantage over the others.

Looking ahead ten years, it is my opinion that the United States output will not increase appreciably beyond the present tonnage of about 800,000 metric tons, but that Chilean output will advance from around 200,000 metric tons to about 250,000 metric tons. Africa's annual output will probably grow from 100,000 tons to about 180,000 tons in ten years. Relatively small increases in output seem likely in other countries, except in Canada, where great increases in the output of copper may be expected as a result of the active development work already in progress in Quebec, the Sudbury district, and in Manitoba.

In the Rouyn area, the outstanding achievement in Canada's mining industry in 1927 was the construction of the Noranda smelter, where copper was poured for the first time on Dec. 16, 1927. Assuming that the 1,000-ton smelter will be stepped up to a capacity of about 1,500 tons daily, the production of blister copper in the present plant will be about 90 to 100 tons daily, and the yearly output will be about 30,000 tons to 35,000 tons of copper.

World Output of Copper

Figures for 1926 taken from the Year Book of the American Bureau of Metal Statistics, 1926; estimates for 1937 by S. J. Cook

	—Metric Tons—	
North America	1926	1937
United States	796,522	800,000
Canada	58,173	230,000
Mexico	56,521	75,000
Cuba	11,824	18,000
Total	923,040	1,123,000
South America		
Chile	202,319	250,000
Peru	38,740	50,000
Others (mostly Bolivia)	7,348	10,000
Totals	248,407	310,000
Europe		
Spain and Portugal	58,000	60,000
Germany	21,600	25,000
Others (mostly Norway, Russia and Yugoslavia)	43,506	10,000
Totals	123,106	95,000
Asia		
Japan	65,570	75,000
Others	4,627	5,000
Totals	70,197	80,000
Australasia	10,200	10,000
Africa	97,987	180,000
Other countries	4,000	2,000
Grand totals	1,476,937	1,800,000

Basing an estimate of the output of copper from the Frood property on the probable demand for nickel ten years hence, it is my opinion that the Sudbury area may be expected to increase its annual output of copper by at least 100,000 metric tons.

Northern Manitoba will have several copper properties in operation. The Flin Flon, with 12,500,000 tons of 2 per cent copper ore and a life of, say, twenty years, should produce 12,500 tons of copper annually.

Less is known about the Sherritt-Gordon property, but it is stated that the tonnage to the 200 level is estimated to be about 2,000,000 tons of 2.3 per cent copper and 5.9 per cent zinc, with 75c. gold and silver per ton. Then there is still some ore in the Mandy. Altogether, the copper properties in northern Manitoba are likely to yield not less than 30,000 metric tons of copper in 1937, and perhaps, 40,000 tons.

230,000 TONS FROM CANADA IN 1937

Assuming that present producers of copper in Canada will still be in operation at about the same capacity ten years hence; or, if any properties are worked out, that they will be replaced by new mines, the present output of copper from Canadian mines may be included in the estimate for 1937. With this present tonnage and the anticipated additional output, the production of copper from Canadian mines in 1937 may be expected to reach 230,000 metric tons, or nearly 13 per cent of the estimated world output of 1,800,000 metric tons.

Some emphasis ought to be laid on the relative accessibility of Canada's leading copper-producing areas. Sudbury, for example, is only about 500 miles distant from New York or Chicago, and this feature is an important factor in the marketing of copper. Even more important is the fact that because such properties are within easy reach of the centers of civilization, they are therefore always likely to draw adequate supplies of labor. Another item in the matter of costs is the richness of some of Canada's copper ores. In addition to copper in the Frood ore, for example, there are nickel and precious metals in sufficient quantities almost to justify the operation of the property for the recovery of only one of these three products. Plentiful labor, rich ore, and relative nearness to the world's greatest copper market are factors that are favorable to Canada's progress as a copper producer.

The accompanying table shows the American Bureau of Metal Statistics figures of copper production for various countries and of the world, together

with my predicted estimates of the copper production by these countries and the world in 1937. S. J. Cook,
Dominion Bureau of Statistics.

Ottawa, Canada.

* * *

American Society of Geophysics

The Editor:

Sir—A letter was recently mailed to the editors of college publications in the United States from a so-called American Society of Geophysics whose address was given as care of Lincoln University, Phelan Building, San Francisco, Calif. It offered honorary membership in the society if the editors would print certain articles advertising the "society" and write certain "testimonial letters." It also offered to pay for advertising space in the publications to which its publicity matter had been sent.

It would appear from the tone of the letter and the extravagant statements therein, that the American Society of Geophysics is a commercial organization for the collection of membership dues from unsuspecting but interested persons. In view of the harm that such an organization may do to the science of geophysics and to science in general, we deem it advisable to issue this warning to scientific institutions and journals that in our opinion the "American Society of Geophysics" is not a reputable scientific organization.

Dr. C. A. Heiland.
John H. Wilson.

Department of Geophysics,
Colorado School of Mines,
Golden, Colo.

[An editorial in *Engineering and Mining Journal* of March 17 drew attention to this enterprise. The confirmatory opinions of Dr. Heiland and Mr. Wilson are welcome. In the meantime it is to be noted that the offer of the promoters has not fallen entirely on barren ground. A contemporary mining publication reprints the statement referred to as "Editorial Discussion"; another broadcasts extravagant claims about geophysical prospecting, "Lincoln University," and the alleged professional standing of the backers of the "Society." —Editor.]

* * *

Tungsten Properties

The Editor:

Sir—In your issue of March 3, you give a list of tungsten properties in this country, and ask for the names of other producing properties not included in your list. I wish to add the names of the "Neumann Group," and the "Keith Property" in Stevens County, Wash. Shipments were made from both these properties during 1927.

Mark J. Sullivan.

Colville, Wash.

Geology and Mining

The Editor:

Sir—The cry has recently been raised—and certainly it is justified—that the average mining operator takes less interest than he should in the application of the scientific principles of geology to the solution of his mining problems; also, that he does not support research work in geology to the extent he does in metallurgy and ore dressing. Geology as applied to mining problems does not seem to be "making good." In fact, a mining geologist of considerable prominence recently made the statement that he has many times considered abandoning the practice of the profession because of this discouraging condition.

What are the reasons and remedies for this state of affairs? One reason is, of course, the nature of the subject itself. Geology is not an exact science, like mathematics, and the amount of accumulated knowledge in proportion to the amount which will eventually be gained is today very small. In the study of a mine or ordinary geological complication, the mining geologist soon realizes that even if he spends his whole lifetime in the study of a small area, he will not have solved all of the questions and problems connected with it. However, during his study he will discover many facts which will prove of great assistance in determining where to look for ore, where to look for faulted segments of known veins, and where it is useless to look for ore, even though he does not solve every problem which arises.

A great advance can be made in gaining the confidence of the mine operator by the geologist if he will keep clear, in his own mind, in his notes, and in his reports, the difference between what facts he has actually determined and what theories he has developed with good supporting evidence, and what theories he has developed with evidence not so good. He should use the greatest care to keep these things distinct, particularly in his own mind, and should carefully label his theories in his reports and cite the supporting evidence, stating whether it is good or only fair. An illustration of the bias with which evidence may be interpreted comes to mind: A specimen which apparently showed an inclusion of wall rock in vein quartz was sent to an advocate of the magmatic-injection theory of vein formation. There was absolutely no way of telling from the specimen whether or not the fragment had been broken from a place near one wall of the vein and whether or not the apparent inclusion might be a portion of a pointed projection of the wall rock into the vein which had been attached to the wall of the vein until broken therefrom by the blow of the hammer when the specimen was secured; yet the report came back that the specimen was proof of the magmatic injection of the vein.

The attitude among geologists that reports must be made in a very positive manner has not always worked out to their advantage. Positive statements of what purport to be facts, but which are really only the theories of the geologist supported by weak or poor evidence, have later been proved erroneous by means of further work on the part of the mine operator, to the great damage of his confidence in the geologist. It must be admitted that positive statements sound better in a report than a great many qualifications, and in some types of work the geologists may think that their own work is the most comprehensive which will be undertaken in the area under consideration, that no better evidence will be developed than their own, and that their theories will not be disputed. This attitude is not scientific, and is particularly out of place in mining geology. The mine operator has at his disposal a much better means of developing geological facts than the geologist, who is unassisted by mining operations. If a contact does not afford conclusive evidence as to the relative ages of rocks where exposed, the mine operator can follow along it with a mine-working, and very probably find a place where the evidence is conclusive. This is even more evident in the case of projected faults and veins and the plotting of fault displacements—the mine-working is the final test.

At times the mining geologist has been severely criticized in connection with suits under the apex law. It has been said that one set of eminent experts will testify to one set of facts and that the experts on the other side will testify to another and entirely different set of facts. The truth is that the evidence given by the really competent mining geologists on both sides is in the closest agreement. The geologist who gets into trouble and brings on this criticism is the theorist who builds up an elaborate structure on insufficient or misinterpreted evidence, with the result that it is torn down by the keen geologists on the other side of the case. The training given geologists in these suits under the apex or extralateral right law is the best to be had for the really practical application of geology to mining. If they state that a thing is a fact, it must be a fact supported by the best of evidence; otherwise the equally keen and well-trained geologists on the other side will tear it to pieces.

The geologist can be of the greatest assistance to the mine operator. He can project the veins and the faults and work out the displacements of the latter in many cases; he can identify and tell the relative ages of the rocks—which rocks are older and which are younger than the veins. The latter are, of course, barren to the particular period of mineralization being considered. But he must not try to give an unqualified answer to every geological question which arises. It can't be done.

To retain (or regain) the confidence of mine operators in geology, let us use the greatest care to keep our minds open to new facts as they develop and not to look at them only in the light of our own pet theories; let us report the facts as facts and the theories as theories, at-

taching in detail the actual evidence developed in every case, and calling attention to all possible interpretations of this evidence. In other words, we must keep separate those deductions on which the evidence is conclusive from those which additional evidence may prove true or false. CHARLES VOLNEY AVERILL.

Piedmont, Calif.

* * *

The Prospects Look Good

THE EDITOR:

Sir—The present situation in the United States indicates no lack of any essential element of prosperity. There is a surplus of every conceivable commodity, including capital, yet two million men are out of work, and a condition of profitless prosperity prevails. The reason appears to be that we produce too much of everything.

We have gone on inventing and using labor-saving machinery until a part of our population can supply all the needs of all the population. At the same time we have reduced waste. We have always been taught that economy was an essential element of prosperity, but I advance the theory that American prosperity in recent decades has depended largely on wastefulness. Each American citizen consumed more of every conceivable commodity that did his foreign cousin. Hence the American farmer, the miner, and the manufacturer could produce more food, more metal, and more goods per unit of population than was produced elsewhere, and sell them at a good price.

During the war we were taught to be saving of everything the army needed. Not only was individual saving stimulated, but numerous waste-product firms were established to reclaim metals and materials that had formerly gone to waste. These two movements still carry on, to the discomfiture of the miner and farmer. For instance, in 1922, 159,560 tons of lead was reclaimed, and in 1926, 277,300 tons was reclaimed. The reclaimed lead of 1927 is nearly twice as much as all the lead produced in the United States in 1895. Prior to the war the amount of reclaimed lead was so unimportant that I find no record of it. The history of reclaimed copper, zinc, antimony, tin, aluminum, and nickel is much the same.

Another factor contributing to the present condition is the decrease in building activities, and this factor in turn is caused by the decreased yearly increment to our population which has occurred in recent years. In the days of our iniquities the nation increased in population at the rate of 2¼ per cent per annum (1860 to 1914). Now that we have become duly reformed it is increasing at the rate of only 1¼ per cent per annum.

The builders, however, have been slow in waking up to this new factor. Cities in particular have persisted in planning developments on the 2¼ per cent increment idea, instead of recognizing the unfortunate fact we are now growing only at the rate of 1¼ per cent per annum. Recently there has been a partial awakening. Many towns find that they are overbuilt. The anticipated increase in population has not materealized; therefore, in some localities a cessation of building operations has resulted. What shall we do to correct this unusual condition? In the abstract the answer is easy—find work for our idle men in non-productive enterprises.

In the days of our forefathers, conditions such as these would have been welcomed with enthusiasm. The ruling monarch would have enrolled an army of a few million men and indulged in the time-honored pastime of kings—warfare. We people of the United States, being opposed to this old fashioned custom, must devise some plan more suited to our democratic ideas.

The following have been advocated: complete the Muscle Shoals plant; build the Great Lakes waterway; harness the Mississippi; build the Columbia River project; build a greater navy; and develop aviation.

It will be noticed that practically all these suggestions involve governmental aid or activity of some sort. Hence the coming Presidential election is of enormous import. If the national government is to embark on a more extensive construction work, it is extremely important that a man with proved engineering and executive ability be elected President. It won't do to elect an orator or a lawyer or a warrior or a skilled politician for this particular job. We must elect a construction engineer and one of great abilities. It is equally important that we select one who is pledged to keep the government out of commercial business as much as possible. GEORGE J. BANCROFT.

Denver, Colo.

* * *

What Is a Mine?

THE EDITOR:

Sir—I believe that *Engineering and Mining Journal* would render a service to the industry if it would promote an open discussion to determine the opinion of the members of the mining profession as to what constitutes a mine. In connection with taxation problems in the metal-mining industry, a definition bearing the approval of the mining fraternity should be of value to the courts. In the compilation of comparative records of production, the formulation of such a definition should avoid the recurrence of statements made in the past which have been misleading, if not wholly inaccurate.

MINING ENGINEER.

Salt Lake City, Utah.

[This subject is of vital interest to the mining industry. Litigation has been resorted to in the past, and attempts have been made to establish a satisfactory definition, but the result has not been what was hoped for. In statistical compilations for the determination of the ranking of producers of a metal or metallic product, this question frequently arises: Must the record of production be limited to ore hoisted through one shaft, when the ore occurs in a continuous deposit that is worked through more than one shaft or other openings; or is a mining claim a mine regardless of whether or not an entry to the underground workings is included within its surface boundaries?

When considered in connection with taxation problems, a satisfactory definition is highly desirable. For instance, a study of the testimony offered and the majority and minority opinions of the court in the Mammoth City vs. Chief Consolidated case, in Utah, indicates the widely divergent opinions that may be held, not only among the members of the mining profession but by the members of as high a tribunal as the Supreme Court of Utah. Consistency is essential; one should not measure a mine by one "yardstick" for taxation purposes and by another for statistical compilations.—EDITOR.]

* * *

Something New in Flotation!

THE EDITOR:

Sir—The practice of flotation has undergone many variations and improvements in recent years. Each innovation has undergone a period of trial, so to speak, when everyone "had to be shown." This is the condition, claimed by the Fairview Mining Company to exist, in connection with present flotation operations at the company's Cardinal property, west of Nederland, in Boulder County, Colo. Flotation operations are conducted in a pulp ground in closed circuit with a 14-mesh vibrating screen. The average flotation millman views such a statement with a decided "I'm from Missouri" attitude; but, nevertheless, it would appear that the company's statements are substantially correct. The ore is pyrite, carrying gold and silver, with minor amounts of galena, in a quartz gangue. Reasonable separation of the minerals is effected at the coarse mesh; otherwise the recovery would be unsatisfactory. The results have indicated much lower grinding costs, increased capacity, and a concentrate more acceptable to the smelter.

The flotation concentrate contains as much as 20 per cent of plus-65-mesh material, and 50 per cent plus-100-mesh. Reagent consumption is slightly higher than it would be if finer grinding was practiced, but that is to be expected. Presumably, the wear on auxiliary machinery and equipment would be increased to some extent, but this factor probably would not be of vital importance. Flotation cells are of the Fahrenwald sub-aëration, mechanical agitation type. The claim is advanced that this cell is particularly adapted to flotation of coarse material because of its principle of operation—passage of pulp by gravity rather than by suction.

The concentrate assays 4 to 5 oz. gold; 60 to 90 oz. silver; 5 to 10 per cent lead; and less than 15 per cent "insoluble," iron and sulphur completing the analysis. Recovery of gold, the major value, is reported to average 93 per cent. HOMAR L. JOHNSON.

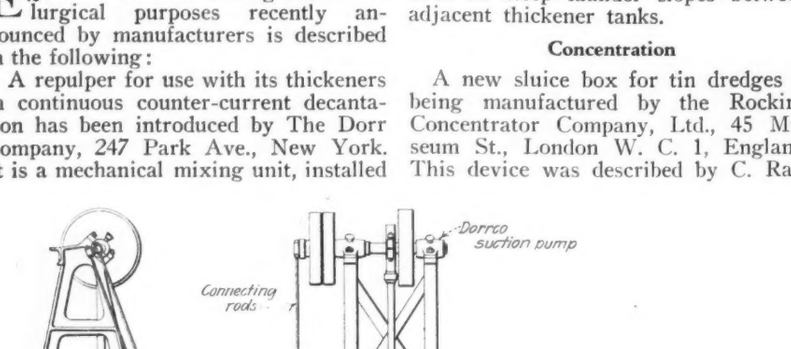
New York, N. Y.

INDUSTRIAL PROGRESS

The Equipment Review

EQUIPMENT for mining and metallurgical purposes recently announced by manufacturers is described in the following:

A repulper for use with its thickeners in continuous counter-current decantation has been introduced by The Dorr Company, 247 Park Ave., New York. It is a mechanical mixing unit, installed in the launders between adjacent thickeners, for effecting a more intimate mixing of solids and wash water than is afforded by simple gravity flow in an inclined, baffled launder. It is shown in the accompanying illustration. On top of a launder of rectangular cross section, extending from the diaphragm pump of one thickener to the feedwell of the next, a shaft extending in the same direction as the trough and parallel with it is mounted on bearings. From this a series of vertical paddles are suspended, with their lower ends immersed in the pulp in the launder. An eccentric on the end of the shaft of the diaphragm pump, which feeds the repulper, is connected to a crank on the repulper shaft by means of an adjustable connecting rod, imparting thereby an oscillating motion to the repulper paddles. These are staggered and set at an angle to the shaft, so that in addition to providing a thorough mixing of the sludge with the wash water, they convey the pulp mechanically to the discharge end of the repulper. Advantages of this device for counter-current decantation include mechanical prevention of segregation of solids in launders; more efficient displacement of dissolved values in the sludge by more intimate contact with the wash water; completion of all leaching or dissolving before the pulp enters the next thickener; and avoidance of steep launder slopes between adjacent thickener tanks.

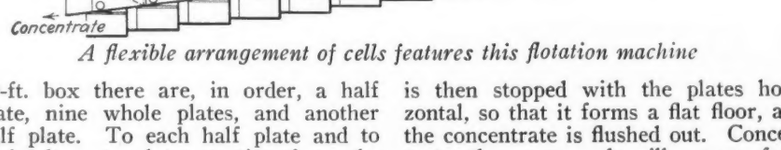


A repulper designed for use with thickeners in continuous counter-current decantation

Concentration

A new sluice box for tin dredges is being manufactured by the Rocking Concentrator Company, Ltd., 45 Museum St., London W. C. 1, England. This device was described by C. Raeburn, of the Geological Survey of Nigeria, in the March issue of *The Mining Magazine*. It is known as the "rocking concentrator," because it consists essentially of a series of rocking transverse steel plates. These work on trunnions let through the side of the box about 2 in. above the bottom. The plates at the top and at the bottom end of the box are halved, so that in each 10-ft. box there are, in order, a half plate, nine whole plates, and another half plate. To each half plate and to each alternate plate, starting from the second whole plate from the top end of the box, is attached a crank. The cranks are fixed to a reciprocating driving bar capable of imparting a movement of about 1½ in., which means a total shift in the rocking plates of ½ in. above and below the horizontal. The plates unprovided with cranks are driven by the others by a spur gear movement. Resting on the plates, and affixed to the inside of the box by bolts and steel strips, is a sheet of flexible rubber which will respond to the plate movement. The steel strips are widened sufficiently to protect the rubber at the point of greatest wear, about 2-in. above the top of the settled concentrate, but in such a manner as will preserve the resilience of the rubber. The cranks of the driving plates are connected to a shaft delivering 30 strokes a minute. Feed from a puddler or from a trommel enters the head box, where it has an opportunity to quiet down into an even flow. The rippling movement given to the floor of the box causes rapid settlement of the heavier minerals at a lower and lower level in the box. Eventually the bottom of the box becomes occupied by a layer of heavier minerals practically uncontaminated by sand and in very slow movement. Above this is the flowing feed, consisting largely of barren sand, moving fairly quickly toward the tail of the box. From time to time, as the layer of tinstone in the bottom of the box deepens, it is necessary to add another 2-in. stop to the riffle at the end of the box. During irregular feed no loss of tinstone can take place, for the end riffle can always be kept at least 2-in. higher than the concentrate bed.

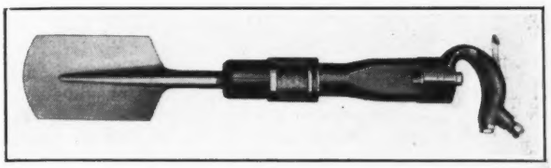
Cleaning up is easily accomplished. The feed is first shut off from the box, water still being supplied in the usual quantity; the concentrator is kept running. This causes a gradual movement of the concentrate toward the end of each box, so that finally it forms a wedge-shaped mass with its broad end against the bottom stop. The machine is then stopped with the plates horizontal, so that it forms a flat floor, and the concentrate is flushed out. Concentrate thus removed will range from about 65 per cent metallic tin at its upper end to about 50 per cent against the bottom riffle.



A flexible arrangement of cells features this flotation machine

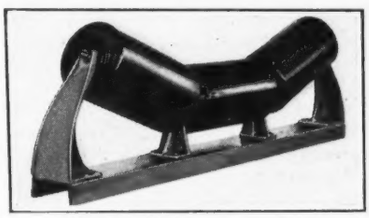
A Flotation Machine

Another concentrating device recently announced is the so called "Gradient" flotation machine, just introduced by the Ruth Company, Denver. The principal feature of this seems to be the arrangement of the cells. Each cell is an individual unit resting on an



A pneumatic digger for use in clay and similar material

individual foundation step. After the foundations are laid, the erection of the machine consists merely in placing the completed units on their respective steps and bolting them down with four anchor bolts, and placing in position the special launder furnished with the machine. The pulp is stepped up. It is fed to the fifth cell of a twelve-cell unit, for example, and progresses from each cell to the next succeeding higher one. In the illustration the cells are numbered from left to right and from lower to higher cells. Cells 5 to 12 are rougher cells, 2 to 4 cleaner cells, and cell No. 1 is the finisher. The gradient is such that it will carry the froth without its settling out or without the launder choking. The froth from each of the eight rougher cells passes downward at the same time that the pulp is passing upward. Three other cells below the roughers (cells 2 to 4) in the same line receive the froth from the eight rougher cells, and the cleaner tailing from each of these cleaner cells is successively elevated to each succeeding cell and



New belt conveyor carrier of improved design

finally enters the first rougher cell, No. 5. The froth from these cleaners is conveyed downward by a superimposed movable launder to the finishing cell, No. 1, where the finished concentrate is made and the tailing delivered to the first cleaning cell, No. 2. This complete operation of roughing, cleaning the froth and finishing it is accomplished without the aid of any outside pumps or elevators.

Crushing and Grinding

Patent No. 1,663,881 has been granted and assigned to the Bradley Pulverizer Company, Allentown, Pa. It covers a mill of the air-separator type and incorporating three new features. The mill was designed primarily as a coal pulverizer, but has been in successful operation, the company says, for more than two years, pulverizing gypsum and similar substances.

A new fine-reduction jaw crusher has recently been introduced by the Good Roads Machinery Company, Philadelphia. In this the roller-bearing mountings are featured. The eccentric shaft for the moving jaw is a special steel forging and is equipped with four Timken and two S.K.F. bearings, which are fitted in bushings, and the whole construction is inclosed at the ends to make them dirt proof. The crusher can handle about 25 tons per hour.

Compressed Air Tools

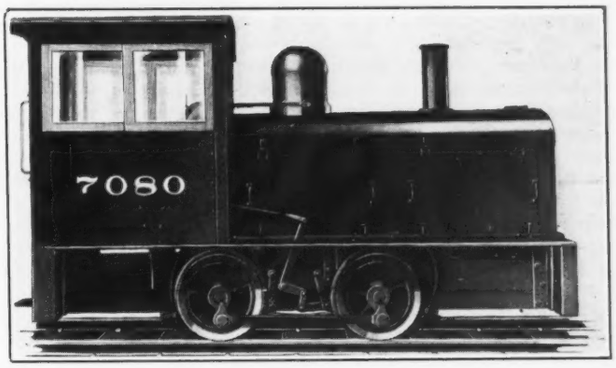
A powerful tool for its weight, according to the manufacturer, is the pneumatic digger announced by Ingersoll-Rand, New York. It is shown in the illustration. Among its novel features are a self-seating plate valve of the flapper type, which gives smooth and positive action, and a tool-retaining device designed to inclose the lower end of the barrel completely, thus keeping dirt out; also to support the lower portion of the shank of the blade and to make it easy to assemble and remove the rubber buffer and blade. This tool has been found suited for tunneling in clay and for similar work. It is 20½ in. long without the scoop and has a 2½-in. stroke. The hose connection is ⅜ in. in diameter.

Power Shovels

A patent, No. 1,663,917, covering a shoveling machine for loading coal and other material, has been granted to the executrix of the late E. C. Morgan. The application was originally filed in 1917. Digging is effected by a scoop actuated by a worm gear. To discharge, the scoop tips upward so that its load slides backwards, down and off its lower edge on to a sloping belt conveyor, which takes the material away from the face and delivers it to a hopper which is an integral part of the machine. From this hopper another conveyor, so designed as to permit a car to be run under it, makes final disposition of the material.

Conveying

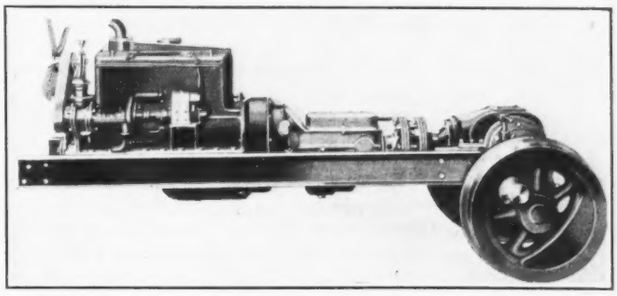
A new belt conveyor carrier, known as the Rex-Stearns, has been announced by the Stearns Conveyor Company, of Cleveland. It is intended for mounting the pressed steel and chilled rim cast-iron idler units. The supporting brackets are of malleable iron. The space between idlers has been lessened to $\frac{5}{16}$-in., so as to decrease the chance of the belt creasing. Any idler may be removed without disturbing the others. The carrier may be had in 18-, 20-, 24-, 30- and 36-in. sizes. The new idler is interchangeable with previous units sold by the company. See the illustration.



A new driving principle is embodied in the design of this gasoline locomotive. The power unit is shown below

Haulage

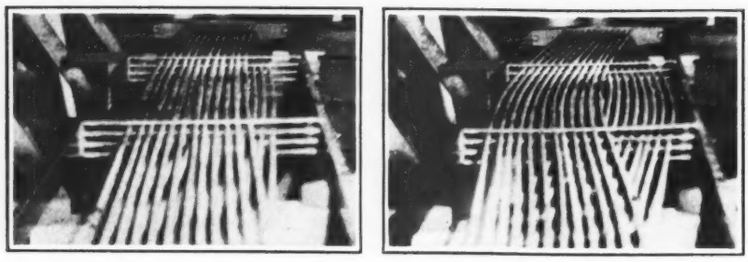
A gasoline locomotive having a new driving principle has been introduced by H. K. Porter Company, of Pittsburgh. It is shown in the illustration. The power plant, clutch, and transmission are mounted on a steel sub-frame and form a straight line drive to the reverse unit. This sub-frame acts as a torque arm pivoted on the rear axle and spring-suspended at the front to the main frame. The rear end of the sub-frame is carried on the main frame by a coil spring. In consequence, the engine, radiator, clutch, transmission, and reverse units are mounted on a sub-frame, which is spring-suspended to a spring-suspended cross-equalized main frame. The main frames and the bumpers are made of rolled steel slabs.



Power unit and transmission of new gasoline locomotive shown above

Refractories

A cement gun for maintaining furnace linings, boiler settings, and similar refractory surfaces has been announced



Scale is automatically cracked from the tubes of this cooler and condenser by the expansion of the tubes when the hot liquid or gas passes through them

by S. Obermayer Company, Chicago. It is claimed that this gun can build up a refractory wall from ½ to 1½ in., mix its own cement mechanically, operate on 30-lb. air pressure, and prevent waste of cement; also that it can be operated by one man and spray 20 gal. with one filling. Each gun is fed by a 20-gal. tank equipped with an adjustable reducing valve suitable for the available air pressure. Air and cement reach the nozzle through two 25-ft. sections of hose. Mechanical mixing of the ingredients is done in the tank by air.

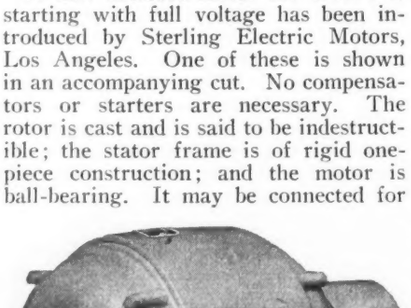
Steam Plant

Gravity driers and pre-heaters for drying and pre-heating coal for purposes of combustion and carbonizing have been announced by Fuel Engineering Company, Ltd., Parliament Mansions, Victoria St., Westminster, England. The coal-fed mechanical stoker should be supplemented with a coal predrier as standard practice in the boiler house, in the opinion of the company. This drier requires no power to operate it, being without heavy moving parts. Waste gases from a boiler or furnace flue or heating air can be used direct as the drying medium. The operation consists of feeding the ore or coal at the top of a hollow wall, through which it descends by its own weight. This wall is constructed to allow hot air or waste gases to be drawn through it and the ore by suction. The size of the plant depends on the nature of the ore, its moisture content, and the duty required. It is said to occupy considerably less space than a rotary drying plant.

A cooler and condenser that possesses the unique feature of automatically cracking off scale deposited on the cooling surface by the cooling water has been announced by the Griscom-Russell Company, 285 Madison Ave., New York. This is illustrated in one of the accompanying cuts. The apparatus consists of a series of Admiralty metal tubes set with an initial curvature into cast-iron headers at each end. The liquid or gas to be cooled or the vapor to be condensed passes through the tubes. The cooling effect is obtained either by showering water down over them from distributing spray nozzles or from a cooling tower set above or by submerging the entire unit in a tank of water. As the cooling water is heated or evaporated on contact with the hot tubes, it leaves behind deposits of scale, which in other types of coolers would continue to accumulate on the cooling surface and gradually decrease the cooling effect until this scale was broken off by hand or by machine. With the G-R Bentube section, as it is called, hand-scaling is unnecessary, as the scale shedding feature automatically prevents the scale from building up to a thickness which would reduce the effectiveness of the apparatus. The scale shedding is effected as follows: When the hot liquid or gas or vapor passes through the tubes, the resulting expansion greatly accentuates the initial bowing of the tubes, as will be seen from the two illustrations in the cut. If the flow of the liquid is interrupted, the tubes again contract to their initial curvature, and it is this change in the flexure that cracks off the scale.

Motors

A new inclosed motor for cross-line starting with full voltage has been introduced by Sterling Electric Motors, Los Angeles. One of these is shown in an accompanying cut. No compensators or starters are necessary. The rotor is cast and is said to be indestructible; the stator frame is of rigid one-piece construction; and the motor is ball-bearing. It may be connected for



An inclosed motor for cross-line starting

either 220 or 440 volts. The same machine may also be made pipe-ventilated, copper-shield protected, fan-cooled, as well as totally inclosed.

General Electric has introduced a complete new line of simply constructed solenoid brakes designed especially for severe service with mill, crane and hoist motors. It is designated as CR-9516, and includes brakes for operation on alternating and direct current. Its construction involves the use of a spring setting device, which is a new feature for a.c. applications. These brakes are said to permit smooth operation when making quick stops in either direction of rotation. The brake mechanism is held in the off position by a coil and plunger; when power is applied to the motor, the coil is energized and the brake released. When the power is shut off, the spring setting device forces the mechanism into the closed or braking position.

INDUSTRIAL NOTES

Robert J. Deneen and Frederic Attwood have been elected vice-presidents of the Ohio Brass Company. Mr. Deneen is in charge of the company's sales activities in the Chicago district, and Mr. Attwood is in New York in charge of the Eastern sales district.

W. H. Norrington has been appointed representative in New York City and vicinity for the C. O. Bartlett & Snow Company of Cleveland. He will maintain his office at 30 Church St.

Following the establishment of a complete manufacturing plant at Belleville, Ont., the Stephens-Adamson Manufacturing Company of Canada, Ltd., has opened branch sales engineering offices at Toronto and Montreal. The Toronto office is in the Bank of Hamilton Building, with A. F. White in charge. George H. Smith is in charge of the Montreal office, in the New Birks Building.

Milton C. Ryer is now representing the Ryer Company, 124 West Fourth St., Los Angeles, which in turn represents the United Swedish Steel Works, of Sweden, and the Heppenstall Knife & Forge Company, of Pittsburgh, in the territory west of Denver and in Mexico. Mr. Ryer was formerly with the Crucible Steel Company of America.

The executive offices of the Worthington Pump & Machinery Corporation, also its export sales department and the New York district sales department, have been moved to 2 Park Ave., New York City.

The last issue of *Demag News*, issued by Demag, Duisburg, Germany, contains several articles of technical interest. These are respectively: "The Utilization of Waste Heat From Large Gas Engines, Industrial Furnaces and Producers"; "Starting Compressors for Diesel Engines"; and "Lifting Magnets."

BULLETINS

PIPE HANGERS — Crouse-Hinds Company, Syracuse, N. Y. Advance Sheet No. 97. Wedgtite pipe hangers for carrying open wires. Also Sheet No. 99 covering self-threading unions and connectors.

MOTORS — Wagner Electric Corporation, St. Louis. Bulletin 151. A new line of air-jacketed motors.

CAR DUMPERS—Roberts and Schaefer Company, Wrigley Bldg., Chicago. Bulletin 103. Rotary car dumper. Eight pages.

NICKEL ALLOY RESISTORS — Electric Controller & Manufacturing Company, Cleveland, Ohio. Four-page bulletin.

NEWS OF THE WEEK

Summary

DEVELOPMENT of mining in Northwest Australia is being hindered by the high cost of transportation. It constitutes the biggest problem facing the Braeside project being undertaken by Russo-Asiatic. Page 631.

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American Smelting will build a lead refinery at Monterey at a cost of about $1,000,000. Page 629.

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Teck-Hughes now stands second among Canada's gold producers and is looking forward to further expansion. Lake Shore, also in the Kirkland Lake district, is preparing to mill 1,000 tons a day. Page 625.

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Magnolia Lead, in the Star district of Utah, has opened a stope of high-grade lead-silver ore. Page 627.

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Cia. Mexicana de Minerales, controlled by Belgian interests, is erecting a lead smelter at Mazatlan to handle ores from Sonora, Sinaloa, and Nayarit. Page 627.

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Basin Cataract Mining is formed to take over the properties of Jib Consolidated, once Montana's foremost gold producer. Page 630.

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Blasting with liquid air is being tested in Germany. It is claimed that this method has lower costs and less danger. Page 630.

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Premier Gold obtains control for five years of Porter-Idaho, which owns properties adjacent to Premier's Prosperity group, in the Portland Canal district of British Columbia. Page 629.

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Manganese was the subject of discussion at a meeting of the Mining and Metallurgical Society of America on April 5. Page 628.

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U. S. Bureau of Mines will soon disclose the results of the investigations conducted by Dr. W. R. Crane in the Michigan copper district. Page 626.

Four Large Copper Interests Unite to Build Refinery in Southwest—Create Joint Agency

A CONSTRUCTIVE agreement was entered into on April 10 by Phelps Dodge Corporation, Calumet & Arizona Mining, New Cornelia Copper, and Nichols Copper, whereby the three producing companies will acquire an interest in the Nichols Copper Company, with the purpose of refining their own copper.

Nichols Copper owns an electrolytic refinery at Laurel Hill, Long Island, N. Y., which is one of the largest copper refineries in the world, the plant being unusual in that series treatment is used. The company has agreed to erect a second refinery at a point in the Southwest, yet to be definitely decided upon, where a portion of the producers' copper will be refined. The remainder of their output will be shipped to New York for refining.

There is also incorporated into the proposed association provision for the creation of a joint selling agency, which will be known as the Phelps Dodge Selling Agency, in which all the above named companies will be interested in proportion to their respective outputs.

It is estimated that it will be at least two years before the completion of the proposed refinery.

Phelps Dodge owns properties at Morenci and Bisbee, Ariz.; Nacozari, Sonora, Mexico; and Tyrone, N. M., as well as smelters at Douglas and Clifton, Ariz. Calumet & Arizona has properties adjoining the Phelps Dodge Copper Queen Branch, at Bisbee, and at Copper Creek, Ariz. In addition, it owns 68.3 per cent of the stock of New Cornelia Copper, the property of which company is situated at Ajo, Ariz.

Teck-Hughes Second Largest Gold Producer in Canada

Lake Shore Preparing to Expand Mill Capacity—Frood Shaft Down 3,000 Ft. at Sudbury

PRODUCTION records of the Teck-Hughes mine, at Kirkland Lake, show that this property is now the second largest gold producer in Canada, being exceeded only by the Hollinger. The two mills of the mine are treating 850 tons a day, with an average recovery of $18 to $20 a ton. Developments on the levels below the 14 are favorable, the ore averaging slightly higher than for the other levels. The high-grade mill treats 600 tons a day and the low-grade mill handles 250 tons. If developments on the lower levels continue to be as favorable as they have been the last few months, the company may build another 300-ton milling unit.

Lake Shore, in the same district, is making additions to its fine-grinding plant, raising its filter capacity, and making changes underground preparatory to bringing the mill capacity up to 1,000 tons a day. It is expected that the mill will be handling this tonnage by June, when the new shaft will be down to the 800 level.

International Nickel's new shaft at the Frood mine, in the Sudbury district, is down 3,000 ft., and preparations are being made to crosscut to the orebody on six levels, spaced 400 ft. apart. The work of conditioning the shaft for permanent operations will take several months, but it is expected that the crosscuts will be started within two weeks. Fraser Brace Engineering, of Montreal, has the contract for erecting the buildings, headframe and ore-sorting plant, in which work 400 men will be employed. This company also has the contract for the International Nickel Company's new power house at Turbine, Ont., which will furnish 30,000 hp.

At the Canusa mine, in the Porcupine district, a pilot mill has been installed and is in operation. About 20 tons of ore is being treated daily. The ore is being extracted from an open trench, 6 ft. wide and 200 ft. long.

A new mining plant is being installed at the Amity mine, in the Boston Creek area of northern Ontario. When put in operation, drifting will be started on the 250 level and will proceed to the southeast a distance of 300 ft., from which point a three-compartment shaft will be raised. Amity is a copper property. It plans to sort and ship the higher-grade ore to the Noranda smelter.

Not having met with even moderately favorable results, the Ribago Copper Corporation has ceased operations in the Rouyn area of Quebec. The management is endeavoring to secure other properties from which better results may be anticipated.

Machinery May Lessen Rand Labor Problem

ALL MEANS which may lead to economy in the number of natives employed are being tried by Witwatersrand mine managements. It is stated that investigations into methods of improving underground practice is being intensified. The Investigation committee of the Central Mining-Rand Mines Group has been undertaking an inquiry into all methods connected with the removal of ore from stopes. All sorts of tools and devices employed have been covered. At the Modder B and Modderfontein East mines, gratifying progress has been recorded in bettering methods on the flat reefs. It is anticipated that data of far-reaching significance will be made available by work being done in this field.

Results of Michigan Copper Researches to Be Made Public Soon

By Paul Wooton
Special Washington Correspondent

THE RESULTS of the work which the U. S. Bureau of Mines has been doing for the last eighteen months in the copper region of northern Michigan soon are to be made public in the form of a bulletin by Dr. W. R. Crane, who has been in charge of the field work. Dr. Crane's studies have included mining practices, ground movement, and subsidence. Before going to the copper country Dr. Crane made similar studies in the Birmingham district of Alabama. He will continue his work in Michigan until the end of the year at least.

Studies directed toward possible improvement in the milling practice in the Michigan copper region are being made by A. W. Fahrenwald, long identified with the Bureau of Mines field office at Moscow, Idaho. In view of his successful work in the Coeur d'Alene district, it is thought probable that he may develop suggestions which may be useful to the mill men in the Michigan district.

In connection with a trip to Colorado to deliver the commencement address at the School of Mines Dr. George Otis Smith, president of the A.I.M.E., will visit a number of the Western sections of the Institute. He will address the Chicago section on May 15, the Denver section on May 17, the Salt Lake City section on May 19, and the Reno section on May 21. Dr. Smith will attend the joint meeting of the Los Angeles and San Francisco sections in the Yosemite Valley May 25, 26, and 27. Secretary Bain will accompany Dr. Smith on the trip. Before leaving for the West Dr. Smith on April 26 will speak on the "Engineer-Citizen" at the dinner of the Lehigh Valley Minerals Conference to be held on that day at Easton, Pa.

Having been invited to provide the program for one of the sessions of the American Zinc Institute, the Bureau of Mines is making every effort to prepare a worth-while presentation of the results of its work which will be of particular interest to the zinc producers.

The President has issued a proclamation increasing the duty on barium carbonate from one to one and one-half cents. This change in tariff will become effective April 26. This applies to precipitated barium carbonate and does not apply to crude ore. The ore is on the free list and cannot be touched by the flexible tariff.

New Railroad May Open Up a New Quebec Mining District

Of particular interest to the mining industry should be the announcement that arrangements have been concluded for the formation of the Quebec Saguenay & Chibougamau Railway in the province of Quebec. This line will afford transportation for what is known as the Lake St. John district, which has been prospected thoroughly in recent years, and will also make accessible the promising Chibougamau mining district.

Hollinger Investigation Is Resumed at Haileybury

The special commission, headed by Judge T. E. Godson, appointed by the provincial government of Ontario to investigate the Hollinger disaster of Feb. 9, has resumed its hearings at Haileybury, Ont. Mine managers from various camps will appear before the commission to suggest the best methods to prevent a recurrence of a similar disaster and also to advise regarding rescue apparatus and mine ventilation. It is expected that the report of the commission will embody recommendations which may result in changes in the mining act.

Property in Kamiskotia Area Purchased for $75,000

Ottawa Kamiskotia Syndicate has secured the George Jamieson property, in Turnbull and Robb townships, in the Kamiskotia area of northern Ontario, consisting of some 100 acres, for the sum of $75,000. As a result of surface showings this property has been considerably in the limelight. On the surface copper, gold gossan, and a dike in greenstone has been revealed. The surface showings indicate chalcopyrite of 2½ to 4 and 5 ft. width. The Ottawa Kamiskotia interests announce that they are now planning active development of this property and they will send in drills and a gang of men at once. They are negotiating for the services of a prominent engineer.

Flin Flon Makes Progress

Designing and preparation of the plans for the concentrator, copper smelter, and electrolytic zinc plants to be constructed at the Flin Flon mine are under way by Hudson Bay M. & S., and railroad construction from The Pas, Manitoba, is being pushed. Fifty carloads of ties were recently unloaded at Mile 22. Poles are being placed under track across muskegs. Steam shovels are working at pits near Mile 12 and Mile 32. Grading north of Cranberry is progressing favorably. Warehouse, office, cook and bunkhouses at Cranberry are 60 per cent completed. The force of men employed now totals 1,250.

Two Law Suits Started Over Stock Deals in Colorado

Atlantic Lode Mining, a company operating three gold claims near Empire, Colo., is being sued by Mrs. B. Rapp, who started proceedings in the Denver district court on March 31 for alleged misrepresentation. Mrs. Rapp claims she paid the company $4,000 for stock, all of which she has not received, and that in addition the affairs of the company were misrepresented. She named three of the officers as defendants.

Coalition Mines & Reduction filed suit in the Denver district court on March 29 against Richard H. and Lillian M. Wilson. The company states that the Wilsons contracted for $10,100 worth of stock, but paid only $400, after the certificates had been delivered to them.

Two Killed at Kirkland Lake When Timber Breaks

TWO MEN were killed in the Kirkland Lake Gold mine on April 1, when a timber, from which a blasting set was hung, broke suddenly. Another of the five men working on the set was badly injured in the accident, which occurred on the 2,800 level, the bottom level of the mine.

An inquest into the accident, held the following day, disclosed that it was caused by a knot in the wood. According to testimony offered, the weight of the blasting set, with chains, amounted to about 2,500 lb., whereas the timber, an 8x8 spruce, on which it was hung was supposed to be capable of sustaining loads up to 30,000 lb. It was testified that all wood is examined at the Kirkland mine before it is used. The jury decided that the deaths resulted from accidental causes.

The dead men are Clifton Purdy and Joe Gabriel.

Magnolia Lead Company Encounters High-Grade Orebody

Large Silver-Lead Stope and Cave Are Opened Up on 175-ft. Level of Property in the Star District of Utah

RECENT DEVELOPMENT operations at the Magnolia mine of the Magnolia Lead Company, situated 12 miles southwest of Milford and 5 miles west of Laho, in the Star district of Utah, have opened a stope of high-grade lead-silver ore 65 ft. long and 32 ft. wide on the 175 level, according to H. S. Joseph, consulting engineer of the company.

The strike was made about 200 ft. southwest of the shaft in a northeast-southwest fissure. In one section of the fissure, a cave 30 ft. long and 15 ft. wide was encountered, disclosing ore 25 ft. in thickness between the level and the top of the cave stope. At the 400 level, at which depth the Magnolia shaft bottoms, the vertical extension of the orebody is expected to be encountered at a distance of 50 ft. The boundaries of the orebody have not as yet been determined.

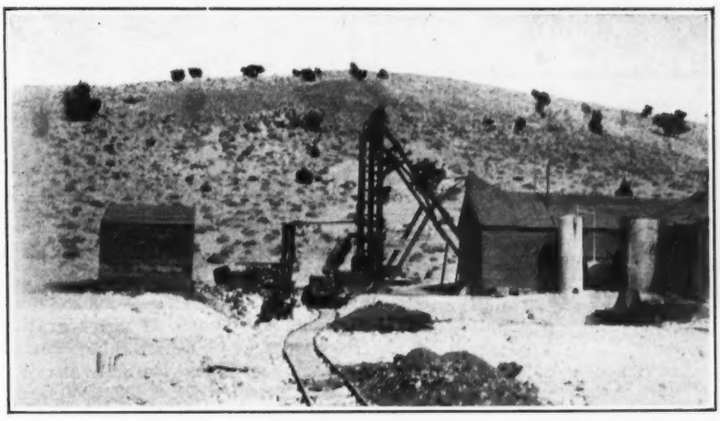
About 5,000 tons of commercial ore have been developed, and one car of ore has been shipped to the smelter at Midvale. A crew of eight men is employed on the property, but this force will be increased early in April.

Equipment on the property includes a 15-hp. gas engine hoist; a 30-hp. Diesel engine-compressor unit; blacksmith shop; bunk house; and boarding house. Three machine drills are operated, and water is obtained by means of a 1½-mile pipe line to Shauntie. A 200-ton ore bin is being moved to the property to replace the 50-ton bin now in use.

Surface operations were conducted on the property some years ago, but the present work dates back to the early part of 1926, when the current development was begun by the Magnolia Lead Company, incorporated in December, 1925. Nineteen claims, totaling 375 acres, comprise the property.

Officers of the company are all residents of Salt Lake City and include Hugh Miller, president; Dr. R. W. Hall, vice-president; D. H. Bullough, secretary-treasurer; and W. C. Adams and C. Morris, directors. A. C. Nebeker is superintendent of operations. The headframe and hoist house and a general view of the property are shown here.

General view of the Star district from the property



The headframe and hoist house, Magnolia mine

Lead Smelter Being Erected at Mazatlan

Cia. Mexicana de Minerales, Controlled by Belgian Interests, to Smelt 100 Tons a Day

GROUND has been broken near Mazatlan, in Mexico, for the construction of a lead smelter by Cia. Mexicana de Minerales. According to present plans, it will be in operation by Aug. 1, 1928. The company is financed by Belgian interests. The plant is to include six brick buildings, with steel upper structure, housing an office, laboratory, ore storage bins, driers, scales, dust chambers, cutters, crushers, furnaces, flumes, mechanical conveyors, and machine-shop equipment. The total investment will amount to approximately $300,000, United States currency, exclusive of funds spent previously in the acquisition and development of 36 mining properties in the states of Sonora, Sinaloa, and Nayarit, from which it is the company's intention to supply a part of the ore for treatment at the smelter, although the bulk, including ores, concentrates, and precipitates, will no doubt be purchased from the several active properties now in production on the west coast of Mexico. The basic production of lead will be pigged and marketed domestically, and the residue, containing gold, silver, zinc, copper, and small quantities of other metals, will be exported to Belgium for treatment in the company's plants at Brussels and Liége. The Mazatlan smelter is scheduled to handle an average of 100 tons of ore per day and will employ from 80 to 100 men, the capacity to be increased in accordance with the ore tonnage available for treatment. According to the supervising engineer, contracts have already been let for the purchase of machinery and equipment.

The construction of a smelter at the port of Mazatlan has been a widely discussed project in mining circles on the Mexican west coast for the last 50 years, and its realization within the next six months is looked upon as an important step toward the ultimate opening up of the vast and practically unknown mineral resources in the three states of Sonora, Sinaloa, and Nayarit.

Owing to the lack of smelting facilities within easy proximity to the mining districts, and the high freight rates prevailing between points on this coast and the United States, numerous mining properties containing ore of high lead and low silver content have remained undeveloped. It appears probable that a smelter at Mazatlan will make practical the working of such properties through the creation of an outlet for lead, which at the current domestic market price should defray the cost of handling and treating the ore, leaving the value of the silver as clear profit to the operator.

The Manganese Situation Reviewed

Need for a Government Stockpile Urged

INTEREST in manganese has been heightened for the moment by the recent news that the work of beneficiating the rhodochrosite ores of the Northwest on a commercial basis has begun at Butte. "Manganese" was the topic selected for the regular monthly meeting of the New York Section of the Mining and Metallurgical Society of America which was held at the Harvard Club on April 5. C. Minot Weld presided.

Reiterating the opinion that a manganese stockpile was a vital need to the government as a safeguard against a future war, the chairman, Mr. Weld, declared that some nations abroad were coming to share this view. At the meeting of the British Iron and Steel Institute last May a similar proposition had been discussed, he said, and it had been pointed out that the British situation with respect to manganese was parallel to ours. Moreover, a study of French imports of manganese ore gave reason to suspect that the French had taken a leaf out of our book and had been establishing their own stockpile.

In the brief historical review of the situation, with which he prefaced his introduction of the speaker of the evening, Mr. Weld said that certain trends four years ago had pointed to a decreased consumption of manganese in the manufacture of the higher alloys which requires so-called ferro-grade ores. One of these trends was toward a greater use of spiegel: the other toward increasing the residual manganese in the bath by adding high manganese pig or even manganiferous ores which would result in a substantial saving of ferromanganese. Recent study, however, seemed to show, said Mr. Weld, that we had been too optimistic. Since 1921 the pounds of total manganese per ton of steel had increased steadily, the average for the three years 1924-1926 being 14.7 lb., against 12.5 lb. for the three years 1919 to 1921. At the same time the per cent of manganese used in the form of spiegel had been sliding off rapidly, from 15.7 per cent in 1916-18 to 6.4 in 1924-26. One thing was certain, he said: estimates of our requirements of ferro-grade ores made four years ago had been too low. We needed the equivalent of from 800,000 to 900,000 tons of standard ferro-grade ores yearly for making steel. In addition, we needed 25,000 to 40,000 tons of chemical ores, and probably the equivalent of 10,000 tons metallic manganese for foundry purposes and special steels.

Where was all this ore to come from, queried Mr. Weld. Of outstanding interest among foreign sources during recent years had been the deposits of the Gold Coast of West Africa, he said. Today the Gold Coast was as important as Brazil. He then introduced the speaker of the evening, Frederick M. Becket, vice-president of the Union Carbide Co., which is heavily interested in Gold Coast manganese deposits.

Mr. Becket's topic was "African Manganese." Today the Gold Coast was one of the four big producers of manganese in the world. These four were Russia, with slightly more than 30 per cent of the total production; India, with a little less than 30 per cent; Gold Coast, with nearly 15 per cent; and Brazil with nearly 7 per cent.

It was probably true, said Mr. Becket, that any two of these four areas could supply the entire world demand for manganese at present. This was particularly significant when it was realized that a substantial disparity existed in production costs in the different areas. A third circumstance making for uncertainty in trends of future production was the fact that tremendous stocks of mined ore produced at low cost were being held against increasing market demand, or possibly for purposes of market influence. These factors accounted for the uncertainty in the future trends of the manganese situation of the world, the speaker said, and made it clear why forecasts were unsafe.

Mr. Becket then gave a résumé of the available information on the African deposits, particularly those which have reached the stage of active production. He had not visited Africa, he said, but had drawn freely on existing literature and had received substantial aid from his associates in the Union Carbide Company.

Technical considerations that determine the manganese producer's decision as to periods and rates of production, as well as the chemical and physical characteristics of the output he undertakes to market, were then briefly sketched by Mr. Becket. In conclusion he said that at present the quantities of all classes of manganese ore offered in the market were more than adequate, the quality of ore offered in most cases was favorable, and the production costs in many fields permitted low prices. In consequence, the purchasers of manganese ore tended to demand high quality. These favorable conditions, however, might change any time.

Discussion

When Mr. Becket had concluded, the chairman introduced J. W. Furness, of the Mineral Resources Division of the Bureau of Mines. On the basis of 1926 production, the world's output today exceeded consumption by 400,000 tons, said Mr. Furness, discussing the outlook as to price. Another noticeable fact, he said, was that the sources from which our ore was drawn were increasing in number, this being probably due to the desire of steel companies to get a better mixture.

The chairman then remarked that it would be well to leave the world situation for a consideration of the domestic field. The dominant factor in the world situation, he said, seemed to be a shortage of demand; in the domestic field the features were a plentiful supply and a good demand so long as the flow of ore was unobstructed. The question of a blockade, which he had previously referred to, was highly important, he said. To discuss domestic reserves was to enter upon too great a debate, said Mr. Weld. But the question of the rate of acceleration of domestic production should be considered, he maintained; also those of beneficiating low-grade ores and of using leaner ores in making steel. He then asked D. F. Hewett, of the Geological Survey, to discuss the first of these questions, that of the rate of acceleration of production.

"Supply at Price"

Two main factors entered into the question of supply, said Mr. Hewett—namely, reserves and the rate of production. In both of these the question of price must be taken into account. The factors affecting the reserve situation were almost legion, and honest well-intentioned men found it difficult to agree. In considering the problem of supply, he said, it was necessary, when stating the size of tonnage available, to say at what price it would become available. The term "manganese ore" today covered materials ranging from 30 to 55 per cent manganese. The plight in which the World War placed us with respect to manganese had given us a fair measure of the number and distribution if not of the size of the domestic deposits. In the last ten years only a few deposits had been found that were not known in 1918. Mr. Hewett then discussed the topic of supply at price along the same lines as those which he had followed at the Cleveland meeting a year ago. He said, in conclusion, that there was no hope of agreement as to reserves unless the price factor were considered.

The Question of Beneficiation

Mr. Weld, now taking up the second question, that of beneficiation of low-grade manganese ores, introduced H. A.

A. F. Taggart on Flotation Will Be a Feature at A.I.M.E. Meeting

FLOTATION will be the subject for the next monthly meeting of the New York Section of the American Institute of Mining and Metallurgical Engineers, to be held at the Machinery Club on the evening of April 25. Prof. A. F. Taggart, of Columbia University, will present the principal paper, but a number of others have signified their intention of contributing to the discussion. Two years ago the same subject aroused an unusual degree of interest, and the progress that has been made in the technique of the process since has been steady, if not startling. The meeting should be well worth attending.

Pumpelly, vice-president of the Domestic Manganese & Development Company. This company has recently undertaken the most interesting manganese beneficiation project ever entered upon in this country, that of beneficiating the rhodochrosite carbonate ores of Butte. Mr. Pumpelly told briefly what he and his associates were doing in Butte and what they hoped to do. Their plant had been started on March 15. Details of this project have already been given in *Engineering and Mining Journal*. He would be interested to see how Mr. Hewett's argument worked out in 1928 under the new conditions of domestic production, he said. His company was now shipping 6,000 tons monthly of a 57 per cent Mn product, from two kilns, and it had facilities for two more kilns. The tariff was very important, he said. Without it there would be no incentive to produce. He referred, in conclusion, to the Bradley-Fitch beneficiation process and said that he understood that Mr. Bradley was almost ready to produce.

Mr. Weld then introduced W. J. Priestley, vice-president of the Electro Metallurgical Sales Company, in order that the latter might discuss the third question—namely, that of substituting leaner ores for those of better grade in making steel. Mr. Priestley framed the question, Why had the consumption of manganese per ton of steel increased, and proceeded to answer it. It had been brought about by the increased severity of consumers' specifications, he said, which had forced steel men to add manganese in the furnace instead of the ladle, giving possibly a 40 per cent greater loss. Another factor had been the demand for more manganese in steel. The consumer today was insistent on getting a better quality of steel.

After a few desultory questions addressed to Mr. Pumpelly with respect to Domestic Manganese company's process, the meeting adjourned.

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Premier Options Porter-Idaho for Five Years

AN AGREEMENT recently made between Premier Gold Mining and Porter-Idaho Mining, both located in the Portland Canal district of British Columbia, gives the former control of the Porter-Idaho properties for the next five years, with an option of acquiring permanent control thereafter.

The Porter-Idaho mine adjoins the Prosperity group, which the Premier company is developing under lease and option and on which substantial initial payments have been made. Porter-Idaho has been handicapped in its development by having to pay charges of $50 a ton for hauling the ore from the mine to tidewater. Last year it shipped 125⅓ tons of selected ore, and accumulated a considerable dump of milling ore. Late last fall the company erected a single line tramway from the mine to a flat, whence there is a wagon trail to tidewater. It is understood that the agreement with Premier includes construction by the latter of a rope tramway.

Jack Waite Mining's Mill to Be Remodeled

Developments at the Property, in the Coeur d'Alene District, Permit Increase to 250-Ton Capacity

OPERATIONS of the Jack Waite Consolidated Mining Company are perhaps the most interesting in the Coeur d'Alene district, Idaho, at this time. Jack Waite was located in the early days and has been developed intermittently. Two years ago it was taken over under lease by M. L. Savage. His work greatly enlarged the possibilities of the mine, so that he was able to build a mill of 100 tons' capacity. Through the efforts of Herman J. Rossi, of Wallace, president of the Jack Waite company, a consolidation of the Jack Waite and Silver King, the latter covering the eastern extension of the Jack Waite vein, was accomplished and Jack Waite Consolidated Mining was organized. The company has been financed to provide for larger operations. It is making the mill an exclusive flotation plant of 250 tons' capacity. The railroad will be extended to within 3 miles of the mill. Concentrate will be delivered by an aërial tramway almost 2 miles long.

Electric haulage is being placed in the mine, and all surface equipment and facilities are to be modernized. A large amount of ore has been developed above the main tunnel level, but some apprehension has been expressed regarding the continuation of the oreshoot below. To settle this question, a shaft is being sunk from the tunnel level following the vein, starting at a point 2,000 ft. from the portal. At this time the shaft is 140 ft. deep. The ore is about 7 ft. wide and recently showed a decided improvement in grade.

The Page mine, in the same district, owned by Federal Mining & Smelting, is a striking example of what the development of the flotation process has done in providing a successful treatment of lead-zinc ores. This mine, originally known as the Corrigan, was extensively developed about eighteen years ago, but finally was abandoned because there was no means of separating the lead and zinc. The presence of zinc made it unprofitable to mine the lead. Encouraged by the success attending differential flotation in the treatment of lead-zinc ore, the Federal company unwatered the old workings to the bottom of the shaft about two and a half years ago. Examination indicated a considerable tonnage of ore, sufficient to justify placing the mine in condition for production, as it responded satisfactorily to milling tests. Equipment of the mine with electric hoist and other modern machinery and construction of a differential flotation mill of 250 tons' capacity resulted. Production started early in 1927, and the report of the Federal company for that year shows a net profit from Page of $70,000. In the meantime the shaft has been sunk 300 ft. to the 900 level, and development there has already resulted in finding larger orebodies in the two veins as well as a better grade of ore. The mill is now handling 300 tons a day.

The Delaware Mines Corporation, which owns the old Rex mine in the Coeur d'Alene district, will soon transfer operations to the Red Monarch tunnel, the extension of which will explore the Rex vein 200 ft. beneath the Rex shaft, 800 ft. deep, with which it will eventually be connected, and provide complete drainage for the mine. The Rex mine is on Nine Mile Creek and the portal of the Red Monarch tunnel is on Beaver Creek, a high divide separating them. The Red Monarch tunnel was driven a good many years ago. It is a large crosscut, 4,400 ft. in length, extending south to within 300 ft. of the Rex vein. It is proposed to extend it to the vein and drift east about 1,800 ft. to a point beneath the Rex shaft, and then raise to connect with it.

A. S. & R. to Build Lead Refinery at Monterey

PLANS have been adopted by the American Smelting & Refining Company for the construction of a lead refinery at Monterey, Nuevo Leon, Mexico. Either the Parkes or the Harris process will be used. Estimates of the cost are about $1,000,000. The company has operated a smelter at Monterey for many years. It is stated that the new plant will be devoted to refining lead derived from mines in the states of Nuevo Leon, Coahuila, and elsewhere. One reason for the erection of a refining plant at Monterey is said to be reduction in costs. The export tax on refined metal is not as high as on unrefined.

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Unwatering of Cliff No. 4 Shaft Practically Completed

UNWATERING of the Cliff No. 4 shaft by Calumet & Hecla is practically completed. The project is the first step in Calumet's program of expansion on the Keweenaw peninsula, in Michigan. The 1,650 or bottom level, however, is badly caved and will need repairs before exploration can be continued. Both of the shafts at the old Phoenix mine are in worse condition than those at the Cliff mine. Repairs will probably delay exploratory work for about a year.

Mayflower-Old Colony, which is drifting west from the 1,700 level, has entered an amygdaloid vein carrying some copper. Drifting is proceeding on the strike of the lode in both directions.

Mohawk had another good month in March, producing over 3,000,000 lb. of mineral, 70 per cent of which was refined copper. It looks as if last year's record output may be exceeded in 1928.

New Interests Acquire Claims Owned by Jib Consolidated

Basin Cataract Mining Formed With Stock of $1,000,000 Par to Take Over Old Montana Gold Producer

BASIN CATARACT Mining Company has been formed to take over the properties formerly owned by Jib Consolidated Mining at Basin, Jefferson County, Mont. The new company is incorporated in Nevada with a total capitalization of $1,000,000, which is divided into 5,000,000 shares of common stock, par value 10c. a share, and 50,000 shares of preferred stock, par value $10 a share.

For a time Jib Consolidated enjoyed the reputation of being the largest gold producer in Montana. In May, 1924, high-grade gold ore was encountered in the old Hope-Katie workings, at Basin. Production during the year totaled more than $700,000. Development work was also undertaken on a faulted portion of the vein lying northeast of the Hope-Katie and known as East-Katie. As a result of poor financing, however, funds for further development were exhausted in paying off debts, and the property shut down early in 1925. Further loss was entailed by attempts on the part of creditors to operate the mine. When it was finally shut down, debts amounted to $631,000.

H. W. Turner, mining engineer of San Francisco, recently examined the properties and cost records of Jib Consolidated, and estimated that for unwatering and reopening a total of $75,000 would be required.

There are 2,600,000 shares of common stock of Jib Consolidated outstanding. Holders will have the privilege of purchasing one share of Basin Cataract at par for each share of Jib Consolidated that they own.

The debts of the newly formed company, under the rehabilitation plan, have been cut down to $400,000 and they have been consolidated and escrowed with the Bank of Italy, San Francisco. One-half of all future operating profits will be used to liquidate the debt. As security, binding the agreement, $400,000 of the preferred stock will be deposited with the Bank of Italy.

Company Organized to Obtain Ore for Ladysmith Smelter

Pacific Tidewater Mines has been organized under a Dominion of Canada government charter, with an authorized capitalization of 5,000,000 shares of no par value and headquarters at Victoria, B. C. The company is closely associated with Ladysmith Tidewater Smelters and the British Metal Corporation. Its chief object is to acquire and develop mines in British Columbia and Alaska to provide ore for treatment at the Ladysmith smelter, on Vancouver Island, or at the British Metal Corporation plant, at Swansea, South Wales.

The new company has acquired an option on the Tyee Mines, at Mount Sicker, Vancouver Island, B. C., which in the past shipped copper-gold-silver ore to the old Tyee smelter. It has also acquired options on eight prospects, two in Alaska and the others in British Columbia.

Striking Evidence of Economy in Use of Copper Cornices

A COPPER cornice on a Salt Lake City building is as good as new after 37 years' exposure to the weather, whereas a more expensive ornate cornice on a comparatively new building has been in service only nine years and has been so damaged by rust that it must be replaced. These facts are presented in an article in a bulletin of the Copper & Brass Research Association, the text of which follows:

"Although the copper cornice on the McCornick Building, in Salt Lake City, has been exposed to the weather since 1891, no expenditure has been made for repairs and the cornice is as good now as when it was installed. A building was erected on the opposite corner in 1919, using corrodible material for the cornice. Within four years $6,700 had been spent for paint and repairs, and it is reported that a similar sum must be expended on this cornice again in the near future. Corrodible cornices must be painted every four or five years in the Salt Lake region.

"The corrodible cornice originally cost $6,000 less than the copper cornice on the McCornick Building, but within a brief period of years about twice this amount will have been spent in maintenance of the rusting material.

"In addition to freedom from upkeep expense, another advantage of the copper cornice is the fact that it will have a salvage value of 35 per cent if the owners of the McCornick Building ever wish to remove it. This is a larger sum than the difference in cost of using copper in place of metal that rusts. The corrodible cornice will have negligible salvage value.

"Another noteworthy example of durable metal in Salt Lake City is the copper cornice on the Dooly Block, which in 37 years has never been repaired. One building in Salt Lake has an ornate cornice that has been in service only nine years. Notwithstanding the fact that it cost more than would a copper one, it has been damaged by rust to such an extent that it must be replaced at once."

Blasting With Liquid Air Tested in Germany

Proponents Claim It Has Advantages of Lower Cost, Less Danger and Simplicity

BLASTING with liquid air is being tried out by German explosives authorities, says H. C. Claiborne in a report made public by the U. S. Department of Commerce. The liquid air method is claimed by its German proponents to offer advantages of lower costs and less danger, and simplicity. Specially constructed carbon cartridges are saturated with liquid air, placed in borings of 70 cm. depth, and exploded by means of an electric fuse. As the oxygen evaporates quickly, it is essential that the explosion take place within 15 min. of loading, and skilled workmen should be employed to prevent loss of time. Special caps and fuses are necessary to withstand the low temperature, but these are claimed to be not more expensive than the usual material. The cartridges are prepared in varying degrees of strength, which makes it possible to regulate the power of the explosion. To obtain one ton of stone about 140 grams of air are necessary.

The element of danger is considered less than in other methods, not only because the unsaturated cartridges and liquid air are equally harmless under separate transportation, but, if a load misses fire, the cartridge can be removed, without possible injury to the workers, within 30 to 40 min., or as soon as the oxygen has evaporated. Compared with other methods, the costs are estimated to be 30 per cent lower. This estimate does not take into consideration the cheaper transport.

It is said that improvements in the process, which, as far as it has been possible to ascertain, is not protected by patent, are being made constantly. In some instances a small air-liquefaction plant is mounted at the spot of operations, which makes it possible to carry on work almost completely independent of the usual sources of explosives.

A method of blasting with water is being applied in Germany at present, particularly in the case of foundations near or within city limits where it is undesirable to cause heavy shocks or concussions. A hydraulic pump forces water under a pressure of 400 atmospheres into specially prepared borings. This method is also recommended for its safety.

Sulphur Deposit Purchased Near Boling, Tex.

Extensive exploitation of a deposit of sulphur near Boling, Wharton County, Tex., will be undertaken by the Union Sulphur Company, which has just leased 80 acres upon which the deposit is located from Mrs. Georgia McCarson. The lease embraces the sulphur and other mineral rights. The consideration was $200,000.

Melbourne Letter

By Peter G. Tait
Special Correspondent

Western Australian Industry Hindered by Lack of Transportation

Melbourne, March 8, 1928.—Although the Australian gold output has shrunk to small dimensions, it must not be assumed that the gold supply is exhausted. The owners of the Golden Age mine, at Menzies, Western Australia, report a yield of 340 oz. of gold from the treatment of 40 tons of ore. This is undoubtedly picked ore and does not represent a run-of-mine sample, but nevertheless it does demonstrate the presence of gold. A mining engineer who was recently engaged on railway construction in Central Australia informed me that, on the Arltunga field, ore averaging 8 oz. to the ton is worthless under present circumstances. Some wonderful yields have been reported from the Tanami mines, in the Northern Territory, but heavy costs also preclude development here.

BROKEN HILL mines recently have been facing three serious problems: lower metal prices, industrial unrest evolving from the termination of the agreement regarding wages, and the prospect of being forced to close down as a result of dry weather, which affected the water power. There is no indication of an early return to higher prices, and consequently only the larger mines with developed reserves can continue to operate. This condition may assist the companies in arriving at an agreement with their employees more in keeping with their ability to pay. Two recent heavy rains have replenished the reservoirs, and there should be no further anxiety on this score for twelve months.

A Northwest Australia project, the Braeside silver-lead deposits, situated 85 miles north of Coongan on the Port Headland-Marble Bar railway, in which Russo-Asiatic Consolidated is interested, would have to pay transportation charges of £11 a ton, under present conditions. Leslie Urquhart, chairman of Russo-Asiatic, says that he considers this proposition "bigger than Mount Isa," the silver-lead mine in Queensland recently taken over by his company. Braeside has been previously submitted to London capitalists, and several mining engineers have reported on it, more or less favorably. The ore deposits extend over a large area, but comparatively little development work has been done. Russo-Asiatic will advance £10,000 and the Western Australian government has agreed to put up an additional £5,000 for a systematic diamond-drilling campaign to determine values at depth. This is undoubtedly the wisest policy to pursue before launching any scheme involving large capital outlay. If the results of this boring are satisfactory, the first necessity will undoubtedly be the construction of a branch railway to Coongan.

British Metal Corporation intends to acquire a substantial interest in the West Australia Manganese Company, Ltd., and will probably control the marketing of the company's product overseas. The manganese company owns properties at Horseshoe, near Peak Hill. A private railway, 86 miles in length, has been constructed to connect with the government railway system at Meekatharra.

London Letter

By W. A. Doman
Special Correspondent

Speculation in Mond Nickel Continues to Feature London Market

London, March 27, 1928.—After last week's sudden rise in Mond Nickel, there has been a relapse. The position of the stock seems very uncertain. There is a rumor that International Nickel was making a bid for the undertaking on the basis of £12 a share. This, as well as several other reports, has been semi-officially denied. A year ago the price was 36s; last week it was £9 5s; and this week it has dropped back to £7 7s. 6d. I understand the amount of the next dividend has been decided, and that in any case it would not warrant the price which can be obtained now for the stock. In some quarters the view is held that the denial of the rumors is simply put forward to enable certain persons who were out of shares to pick up cheap stock.

A requisition meeting of shareholders of the Mexico Mines of El Oro was held in Paris on Saturday, and proved a rather turbulent affair. As the shares are in bearer form, it was not possible to get at all the holders, but about 120 were present. It is really not easy to determine the result of the meeting, owing to the uproar and to the fact that a poll was taken after some holders had left. The company, it seems, has about £175,000 in cash, and this and some new shares were to be used to buy up a timber property in Brazil, without, according to some shareholders, a proper investigation being undertaken.

AFTER a prolonged and rather disconcerting fall in price, tin is on the up grade again, and some producers are becoming bullish. Not all, however, for at the meeting of Gopeng Tin a few days ago the chairman said that though he expected the lower prices to stimulate consumption, he "did not see how we can expect higher prices for the metal at present, in view of the increased production caused by a large amount of fresh capital put into the industry during the last two years."

Mexico City Letter

By W. L. Vail
Special Correspondent

Suggested Tariff on Lumber Arouses Opposition of Mining Men

Mexico City, April 2, 1928.—Efforts on the part of local lumber dealers to obtain an increase on duties for imported lumber and mining timbers have met with strenuous objections from mining companies throughout Mexico. Imported timbers, particularly for the northern mines, run into many millions of board feet annually, and an increase in duty would seriously affect mining costs. The Mexican tariff commission is now considering the question.

That metal exporters are serious in their intention to divert shipments from Tampico because of the charges for handling at that port is evidenced by the fact that 100 carloads of metals passed through Laredo, Tex., during March, en route to Corpus Christi, where they will be exported to European centers. Formerly these shipments were sent to Tampico.

A PRESIDENTIAL decree was recently issued permitting the introduction of foreign currency into Mexico. It was found that the restriction on its use along the American border and on the sea coast had hindered trade to an appreciable extent. The Secretary of the Treasury, however, is authorized to suspend the decree at any time that a particular denomination becomes prejudicial to local currency.

El Bordo and El Cristo properties, in the Pachuca camp, have requested permission to suspend operations because of the prevalent low prices for metals.

Reports from Michoacan state that a body of ore has been struck in the Carriles and Dolores tunnels, at Angangueo, large enough to justify milling 200 tons a day. The properties belong to American Smelting & Refining.

The commission appointed by the Mexican government to investigate the causes of the catastrophe at the Aurora mine, Teziutlan, State of Puebla, in which 26 men lost their lives, has found the company blameless.

Diamond drilling is now proceeding on the Naples property, Chico district, State of Pachuca, which was recently taken over by the Real del Monte company on a participation basis. The company has also recently acquired the Fraternity mine, in the same district, under similar conditions.

The Puerto Corral mine, at Guerrero, has voted to increase its capital stock 2,500 shares at 40 pesos a share. Most of the new stock has been subscribed for in advance by present shareholders. The new flotation plant will be installed within a few weeks. Tonnage now blocked out for the mill is sufficient for several months at capacity operation.

Personal Notes

J. PARKE CHANNING is now a resident of Berkeley, Calif.

WALTER HOVEY HILL, consulting mining engineer, is in New York.

J. H. CURLE, mining engineer and author of "Today and Tomorrow," left South Africa recently for Australia.

MAX M. DIXON, British consulting mining engineer and geologist, is in Anatolia conducting an extended series of examinations.

ARMY ADAMS, consulting engineer of Grass Valley, Calif., is in Mineral County, Mont., engaged in developing placer operations there.

PERCY E. HOPKINS, consulting geologist, is in charge of operations on the Nortricia property, in the Red Lake area of northern Ontario.

WALTER J. BROWNING, for twenty years manager of mines for Rio Tinto, has resigned. P. S. COULDREY, technical deputy manager, succeeds him.

M. F. TYNAN, consulting mining engineer, is now with the Charcas unit of the Compania Minera Asarco, situated at Charcas, San Luis Potosi, Mexico.

DR. ROBERT H. BRADFORD, professor of metallurgy at the University of Utah, is on a three weeks' leave of absence, during which he will be at Savannah, Missouri.

THOMAS SUTHERLAND, chief mine inspector for the Province of Ontario, was in Washington last week conferring on safety matters with officials of the U. S. Bureau of Mines.

ROBERT WILLIAMS, vice-president of Union Minière du Haut-Katanga and manager of Tanganyika Concessions, has returned to London after a visit to Egypt and the Sudan.

C. W. HENDERSON, of the Denver office of the U. S. Bureau of Mines, spoke on "Topographic and Geologic Mapping in Colorado" at a recent meeting of the Colorado Engineering Council.

A. G. MACKENZIE, secretary of the Utah Chapter of the American Mining Congress, left Salt Lake City on April 4 on a three weeks' business trip to Washington, D. C., and New York City.

CECIL BAKER, director of the Consolidated Goldfields of South Africa, has passed through San Francisco after a visit to the Searles Lake plant of the American Potash & Chemical Corporation.

H. R. NORSWORTHY is in charge of the potash operations of the U. S. Bureau of Mines during the absence of J. S. WROTH, who is in Europe gathering information regarding potash properties there.

Sir ROBERT N. KOTZE, at one time government mining engineer for the Union of South Africa, recently was elected to the board of directors of the Johannesburg Consolidated Investment Company, Ltd.

OLIVER C. RALSTON, superintendent of the Berkeley station of the U. S. Bureau of Mines, has resigned. Mr. Ralston has accepted a position conducting research experiments with one of the large copper companies.

R. F. MCELVENNY, recently appointed to take charge of the western department of American Smelting & Refining, has completed a short tour of the company's properties and is now making his headquarters at Salt Lake City. Mr. McElvenny, a graduate of the Colorado

R. F. MCELVENNY

School of Mines in 1903, was manager of the Garfield, Utah, smelter from 1917 to 1920. He successively held the offices of manager of the Omaha lead refinery of the A.S.&R., consulting metallurgist at Salt Lake City, and manager of the Colorado department, until the early part of 1927, when he was appointed manager of the Tacoma, Wash., smelter. As manager of the western department Mr. McElvenny succeeds H. Y. WALKER, recently promoted to a vice-presidency.

F. L. BOSQUI, consulting metallurgical engineer for South African companies engaged in platinum mining, was recently in San Francisco and is now in the Southwest, where he is investigating developments in milling and flotation.

President E. H. WELLS and Prof. A. S. WALTER, of the New Mexico School of Mines, are in charge of the annual tour of the senior class, on which a number of mines, mills, and smelters are visited. The tour started April 7.

R. S. G. STOKES, assistant general manager at the De Beers Mines, Kimberley, South Africa, for the last eight years, has resigned and will join the staff of the Corner House, at Johannesburg, in the capacity of consulting engineer.

JAMES WHITEHORNE, one of the consulting mining engineers on the staff of the Central Mining & Investment Corporation, Ltd., of Johannesburg, has resigned his position. Mr. Whitehorne intends to establish an office in London for the practice of his profession.

DR. RALPH H. MCKEE, professor of chemical engineering at Columbia University, has been elected a director of the Parmac Porcupine property. He will make an examination of the property, which adjoins the Coniaurum, in the Porcupine district of northern Ontario.

HUGH R. VAN WAGENEN, consulting mining engineer, is returning to Los Angeles from New York after an extended examination of gold mines in Colombia. Mr. Van Wagenen comments on the use of the airplane and the radio in Colombia, stating that he traveled 400 miles by the former, and heard Schenectady, N. Y., by the latter.

DR. VICTOR DOLMAGE, head of the British Columbia Geological Survey, spoke at a recent meeting of the Winnipeg Board of Trade on the conditions of the mining industry in British Columbia. He emphasized the importance of the new metallurgical processes which have rendered many old mines and prospects profitable by the extraction of metals that formerly were wasted.

A. W. FAHRENWALD, ore dressing engineer of the U. S. Bureau of Mines, who has been at Houghton, Mich., for the last two months studying the milling practice employed in the Michigan copper districts, visited the Intermountain Station of the U. S. Bureau of Mines at Salt Lake City on April 3. Mr. Fahrenwald was en route to Moscow, Idaho, where he will resume his duties as supervising engineer of the Moscow Field Station of the Bureau, situated at the University of Idaho.

E. E. CAMPBELL, mining engineer, has been appointed general manager and consulting engineer for Old Colony Mines, Ltd. He will leave his present post at Toronto for Kingman, Ariz., to start operations at the company's properties there, after which he will go to Newfoundland to make an examination of Old Colony's 48,000 acres, adjacent to the Buchans River mine of the A.S.&R. Mr. Campbell was formerly assistant general manager of Granby Consolidated and for the last five years had been in charge of the mining interests of R. W. Wood, president of Premier Gold Mining.

OBITUARY

JAMES DUFFIN, at one time superintendent of mines for Cananea Consolidated Copper at Cananea, Sonora, Mexico, died at his home at Claremont, Calif., recently. Mr. Duffin was 57 years old.

MATT BRODIE, manager for Asia of the Sullivan Machinery Company, with headquarters at Tokio, Japan, died recently. Mr. Brodie was a graduate of the Massachusetts Institute of Technology. He joined the Sullivan company immediately after graduation in 1902.

Market and Financial News

Metal Prices Affected by Low Howe Sound Earnings

DURING 1927 the Howe Sound Company maintained production at its Britannia mine, in British Columbia, and at its El Potosi and Calera properties, in Mexico. The only interruption was caused by the large flow of water encountered in the Calera mine, but this condition was remedied by the end of the year. Announcement was made of the establishment of an exploration department with John G. Barry in charge. Mr. Barry's headquarters are in El Paso, Tex.

Lower prices for copper, lead, and zinc in 1927 are reflected in the company's earnings. Development work has been actively carried out and the known ore reserves have been extended. Present equipment has been thoroughly modernized, and it is expected that capital expenditures during 1928 will be lower, because of this condition.

Comparative Metal Production

Fourth Quarter	Gold Oz.	Silver Oz.	Copper Lb.	Lead Lb.	Zinc Lb.
1927	3,018	808,542	9,242,919	19,180,971	13,177,105
1926	2,454	576,061	7,893,427	14,183,604	13,293,644

Comparative Financial Statements

Fourth Quarter	1926	1927
Value of metals produced	$3,333,742	$3,438,838
Operating costs	2,533,892	2,798,102
Operating income	$799,849	$640,736
Miscellaneous income	69,094	78,388
Total income	$868,943	$719,125
Less depreciation	192,793	266,764
Net income	$676,150	$452,360

The income account for 1927 compares with the corresponding figures for 1926 as follows:

	1927	1926
Gross income	$13,393,179	$13,797,373
Operating costs	10,314,807	10,154,224
Operating income	$3,078,372	$3,643,149
Miscellaneous income	352,349	211,704
Total income	$3,430,721	$3,854,853
Depreciation, taxes	1,288,605	762,762
Profit before depreciation	$2,142,116	$3,092,091

Inspiration Earnings Lower in 1927

Inspiration Consolidated Copper Company's annual report shows net income of $729,694 for 1927, after federal taxes, depreciation, and interest, but before depletion. This is equivalent to 62c. a share and compares with $1.10 per share, or $1,310,896, in 1926. Income accounts for 1927 and 1926 compare as follows:

	1927	1926
Sales of copper	$12,817,599	$10,721,993
Operating expenses, including fed. taxes	10,885,097	9,132,150
Depreciation	751,897	348,872
Gross profit	$1,180,605	$1,240,971
Other income	32,718	69,925
Total income	$1,213,323	$1,310,896
Interest	483,629	.....
Net income	$729,694	$1,310,896
Dividends	295,491	2,363,934
Surplus	$434,203	$(a) 1,053,038
Previous surplus	6,686,879	7,739,917
Profit-and-loss surplus	$7,121,082	$6,686,879

(a) Deficit

Inspiration produced 88,374,049 lb. of copper during the year—36,909,508 lb. from concentrating ores, 51,284,096 lb. from leaching ores, and 180,415 lb. from direct-smelting ores. A total of 5,111,108 tons of ore was mined, of average grade 1.094 per cent copper. Cost of producing copper was 11.5215c. per pound, including depreciation but excluding federal taxes and depletion. Ores for concentration were mined at the rate of 10.552 tons per man-shift; leaching ores were extracted at 12.448 tons per man-shift. A large tonnage of low-grade oxidized ore is being extracted and stockpiled for subsequent heap leaching.

Ahumada Operations on Smaller Scale in 1927

Ahumada Lead Company, operating in Chihuahua, Mexico, reduced the scale of its operations appreciably in 1927. The reasons given were the low price of lead, flooding of the company's principal underground workings, and the delay occasioned in installing equipment to handle the large flow of water encountered.

The relation of operations in 1927 to those in 1926 is indicated in the following table:

	Pounds of Lead Produced 1926	1927
First quarter	10,147,347	9,425,756
Second quarter	10,128,008	6,438,667
Third quarter	10,532,741	5,055,222
Fourth quarter	10,905,309	3,446,060

Consolidated income accounts for 1927 and 1926 compare as follows:

	1927	1926
Sales of lead and silver	$1,817,520	$3,691,027
Operating profit	96,325	813,426
Depreciation	(a) 87,893	44,759
Balance	$8,432	$768,667
Other income	191,967	298,056
Profit	(b) $200,399	(b) $1,066,723
Dividends	149,002	1,072,816
Surplus	$51,397	(c) $6,093

(a) Before depletion. (b) Includes $40,184 unproductive prospecting written off. (c) Deficit.

Erupcion Mining Company, a subsidiary of Ahumada, mined 10,302 tons of ore in 1927, compared with 28,607 in 1926, and produced 4,931,051 lb. of lead and 68,658 oz. of silver, compared with 13,875,767 lb. of lead and 226,511 oz. of silver in 1926. No change in the ore outlook has occurred and the prospect is for diminishing output, as little new ore is being developed.

At the annual meeting of Ahumada Lead Company, held since the foregoing report was issued, the following officers were elected: O. R. Whitaker, president; H. G. Dudley, vice-president; John B. Rawlings, secretary; C. B. Valle, treasurer; George H. Cobb, and J. W. Allen, assistant secretary-treasurer. Drastic changes in the 1927 scheme of operation are to be effected, although details are not yet available.

Premier Earnings Show Small Decrease

The annual report of the Premier Gold Mining Company, Ltd., operating in the Portland Canal district, British Columbia, shows total earnings, for 1927, of $2,201,406 before deducting administration expense, taxes, depreciation, and ore depletion. This compares with $2,211,490 earned in 1926, when the average price of silver was 5.74c. per ounce higher. Had the price of silver during 1927 been the same as in 1926, the total earnings would have been increased by $180,000. Total production costs were nearly $1 per ton lower in 1927 than in 1926. Ore reserves were decreased by 163,732 tons during the year.

Financial Results in 1927 and 1926

	1927	1926
Value of ore sold	$3,737,565	$3,782,032
Operating expense	1,579,262	1,582,401
Total earnings	$2,201,406	$2,211,490
Taxes, depreciation and depletion	1,369,655	1,414,362
Available for dividends	$831,751	$797,127

Dividends amounting to $1,601,062 were paid during the year, of which $769,311 was return of capital accrued through the reserve accounts set up for ore depletion and depreciation.

BENGUET CONSOLIDATED MINING COMPANY, operating a gold and silver mine in the Philippine Islands, reports net profits of 584,344 pesos for 1927. The estimated gross value of ore reserves increased 2,000,00 pesos during the year. The following tables are from the report of A. W. Beam, president:

Receipts

	Pesos
Bullion	2,073,981
Exchange	9,261
Interest	41,166
Rentals	4,739
Store operation	27,562
Bodega operation	24,030
Total	2,180,739

Expenditures

	Pesos
Labor	519,858
Supplies	509,347
Taxes	43,812
School and hospital	15,924
Insurance	4,925
Marketing bullion	18,249
Mine miscellaneous	135,734
Manila office	73,195
Total	1,321,044
Gross profit	859,693
Less depreciation	228,690
Less development	30,604
Less reserve for ore depletion	1,071
Total	599,327
Less bonus to general manager	14,983
Net profit	584,344

Treadwell Yukon Reports Progress in Development at Errington Mine

UNDER date of March 17, 1928, P. R. Bradley summarizes, in the company's annual report, progress at the Treadwell Yukon properties. At the Errington mines, $85,000 remains to be paid under existing options, of which $75,000 is payable in 1928. Living accommodations for 300 men, a water system, 12 miles of transmission line, and other appurtenances have been provided. Construction of mill was expected to be finished by April 15, 1928. No further sinking was done on No. 1 shaft; the 300 level was extended 3,487 ft., making the total of exploratory work 9,086 ft. The Ollier orebody above the 300 level has 1,000,000 tons of ore developed; assay of all samples averaged 0.021 oz. gold and 2.15 oz. silver per ton; 1.33 per cent copper; 1.33 per cent lead, and 5.74 per cent zinc. Gross assay value was $13.14 per ton. By sorting out waste rock and low-grade ore an enrichment of mill feed to $17 per ton is expected.

No. 2 shaft was sunk to a depth of 600 ft., and stations were cut at 300 and 500 levels. Connection was made between No. 1 and No. 2 shafts on March 1, 1928. Crosscutting opposite No. 2 shaft disclosed a 16-ft. ore band of average assay: 0.015 oz. gold; 1.80 oz. silver per ton; 0.54 per cent copper; 3.4 per cent lead and 9.11 per cent zinc. Gross assay value was $16.35 per ton. Mr. Bradley states that the same part of the mine has been more recently prospected by diamond drilling. The original hole, B-43, showed a width of 74 ft. of ore of average gross value $17.12 per ton. One of the recently drilled holes intersected the same ore 100 ft. higher, showing 37 ft. of ore of average gross assay value $16.12 per ton. The second hole to the west of and below hole B-43 has cut 34 ft. of ore in two sections of average gross assay value $9.81 per ton. The three drill holes indicate a large ore tonnage.

No. 3 shaft, 11,000 ft. east of No. 2 shaft, will be started as soon as weather conditions are favorable. The purpose of the shaft is to explore the eastern end of the property where favorable results were obtained by diamond drilling.

At the Wernecke mines, Y. T., an operating profit of $279,369 was made in 1927 from 2,411 tons ore and concentrate shipped.

At the Tybo, Nevada, properties the mine is being prepared for production of 200 tons per day, and a new shaft will be raised from the 710 level to the surface. A 200-ton mill and other buildings will be erected, involving an outlay of $350,000. It is expected that the mill will be in operation about Oct. 1, 1928. Options have been secured upon sixteen adjoining groups of claims.

U. S. Steel Corporation in 1927

THE report of the Steel Corporation for 1927 indicates that operations, in general, were satisfactory, although conducted on an appreciably reduced scale. The financial statement follows:

Income Account for 1927

Total earnings were, after deducting all expenses incident to operations, including ordinary repairs and maintenance (approximately $114,000,000), allowance for employees' profit sharing fund, and taxes (including reserve for federal income taxes), per consolidated income account		$172,315,489
Less interest on outstanding bonds and mortgages of the subsidiary companies		7,991,113
Balance of earnings in the year 1927		$164,324,375
Less charges and allowances for depletion, depreciation and amortization applied as follows:		
To depletion and depreciation reserves of subsidiary companies	$47,390,338	
To sinking funds on bonds of U. S. Steel Corporation	11,515,668	58,906,007
Net income in 1927		$105,418,368
Deduct		
Interest on U. S. Steel Corporation Bonds outstanding:		
Fifty-year 5 per cent gold bonds	$8,759,259	
Ten-sixty year 5 per cent gold bonds	7,914,916	
	$16,674,175	
Premium paid on bonds redeemed by sinking funds:		
On subsidiary companies' bonds $320,215		
On U. S. Steel Corporation Bonds 1,078,000	1,398,215	18,072,390
Add net balance of sundry receipts and charges, including adjustments of various accounts		550,858
Balance		$87,896,836
Dividends for the year 1927 on U. S. Steel Corporation stocks:		
Preferred, 7 per cent	$25,219,677	
Common, 7 per cent	49,813,645	75,033,322
Surplus net income in the year 1927		$12,863,514

Productive mining operations of the corporation show a greater percentage of decrease than is observed for the finished products of the steel mills. Universal portland cement is the only item showing an increase in production. The following is a condensed summary of comparative production:

	1927 Tons	1926 Tons	Decrease Tons	Decrease Per Cent
Iron and manganese ore	25,646,927	29,262,741	3,615,814	12.4
Limestone, dolomite and fluorspar	4,456,150	5,513,739	857,589	15.6
Coal	27,430,329	34,294,657	6,864,328	20.6
Coke	14,506,980	17,336,334	2,829,354	16.3
Pig iron, ferro and spiegel	13,784,226	15,705,301	1,921,075	12.2
Steel ingots (bessemer and open hearth)	18,486,444	20,306,668	1,820,224	9.0
Rolled and finished steel products for sale	12,979,282	14,334,412	1,355,130	9.5
	Bbl.	Bbl.	Increase	
Universal portland cement	15,425,000	14,526,000	899,000	6.2

STATISTICAL NOTES

PORTLAND GOLD MINING COMPANY, operating in the Cripple Creek district, Colorado, incurred a loss of $199,187 in the operation of the company's properties during the year 1927. The following table summarizes the financial results:

Gross value of ore mined and shipped		$149,301
Gross values recovered by mill		660,292
Total gross value		$809,594
Net cost of mining and milling		1,008,782
Loss from operation of mines and mill		$199,187
Profit and Loss for Year 1927		
Loss from operations		$199,187
Interest received	$6,202	
Discount and exchange	1,043	
Registration fees	60	$7,306
Loss before depreciation and depletion		$191,880
Depreciation	$107,783	
Depletion	46,928	154,711
Final loss—to surplus		$346,592
Surplus		
Balance Jan. 1, 1927		$1,166,400
Loss for the year 1927	$346,592	
Dividends paid	120,000	466,592
Balance Jan. 1, 1928		$699,807

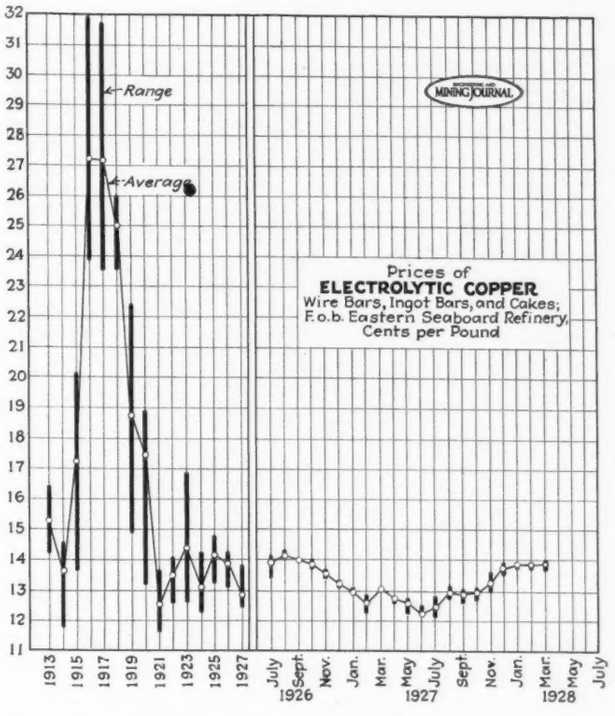
Development to the extent of 5,196 ft. was done during 1927.

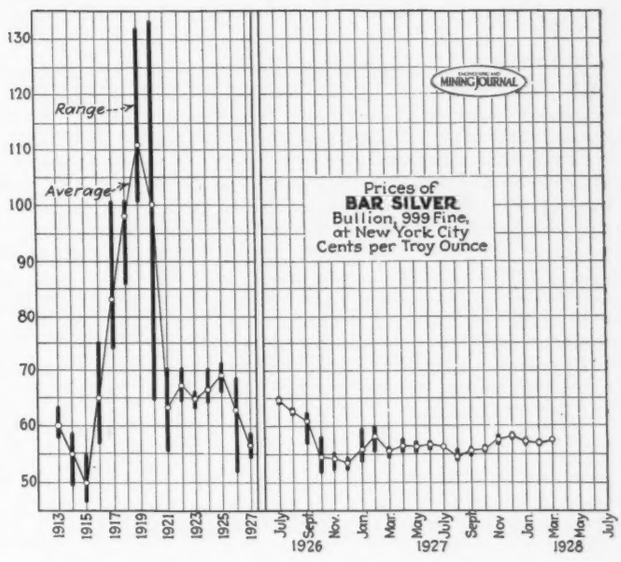
ONVERWACHT PLATINUM, LTD., operating in South Africa, milled 2,195 tons of ore during January and recovered metal of the platinum group estimated at 518 oz., equal to 4.72 dwt. per ton milled. In December, 2,124 tons of ore yielded 578 oz. of refined platinum, equal to a recovery of 5.44 dwt. per ton crushed.

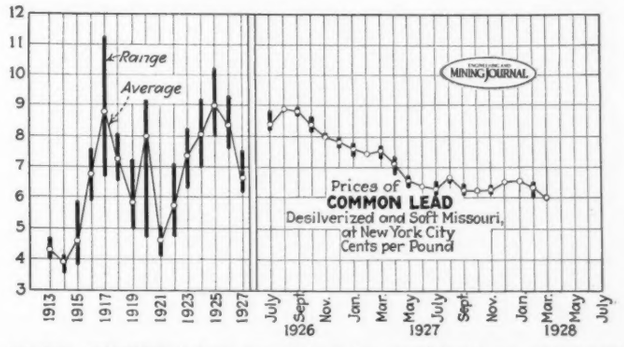
LYDENBURG PLATINUM AREAS, LTD., operating in South Africa, milled 2,800 tons of ore in January, winning 571 oz. of platinum group metals, against 541 oz. in December from a similar tonnage crushed.

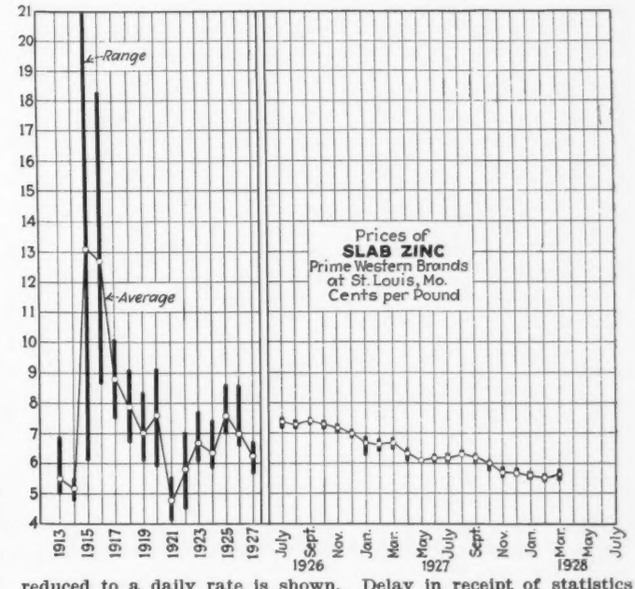
VANADIUM CORPORATION OF AMERICA, operating the Mina Ragra, in Peru, reports, for 1927, net earnings from operation of $2,221,374. Dividend disbursements amounted to $1,506,548. The balance on hand, in consolidated earned-surplus account, amounted to $2,996,293. Appropriations for improvements to the corporation's properties include items for the erection of a concentration plant at Jumasha, Peru; the erection at the Bridgeville (Pa.) plant of additions to the ore-preparation department which will permit the production of increased tonnage in vanadium pentoxide and other products; an extensive exploration campaign; general improvements at the Niagara Falls plant; and an improvement of storing and shipping facilities at both the Bridgeville and Niagara Falls plants.

Metal Price Curves

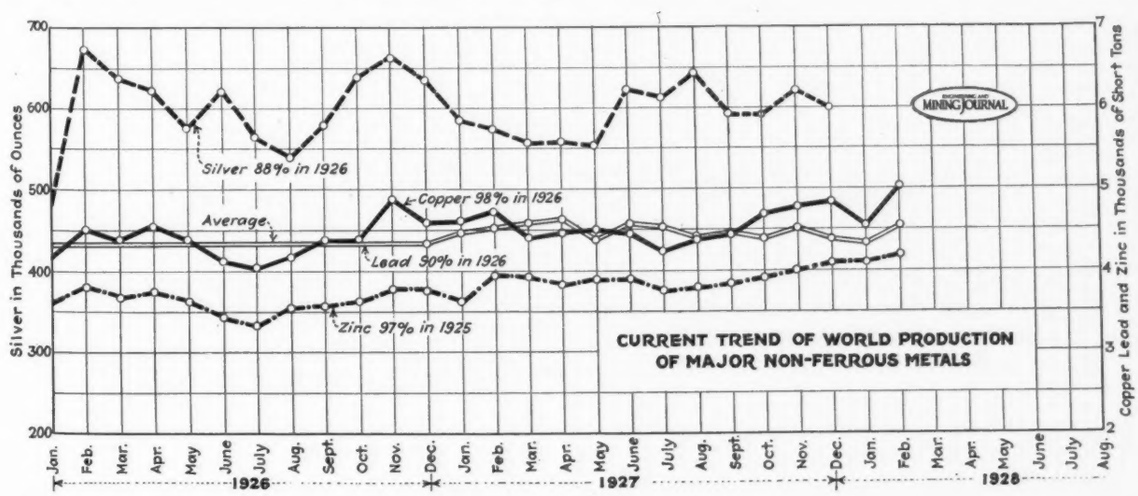








THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The figures for lead on the new basis are not available for the individual months of 1926, and accordingly a horizontal line showing the monthly average reduced to a daily rate is shown. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.



Review of Current Statistics

By Homar L. Johnson
Editorial Staff

MARCH saw another decline in *Engineering and Mining Journal's* Weighted Index of Non-Ferrous Metal Prices. However, all the news was not so bad as that statement might indicate. As in February, lead was the leader in the decline, and, except for tin, was the only metal of the group to undergo depreciation in value during the month. Zinc, silver, and copper were higher in March, and, in the order named, tended to offset the lead and tin decline. Aluminum and nickel were unchanged, as in February. The Non-Metallic Mineral Index continued unchanged from February and January.

Share Indices Advance

Among the other indices the general tendency is upward. The stronger tone of the copper market, at present, has shown itself several times over in the appreciation resulting in the share quotations of the various copper companies. This condition is a contributing factor in the advance in *Engineering and Mining Journal's* Weighted Index of seven Mining-Smelting-Manufacturing companies, as several companies in this group have some direct interest in the copper situation. International Nickel was the big factor in the March advance, as it was in the February decline, with Anaconda and A.S.&R. as major assistants. Each of the four others of the group, New Jersey Zinc, American Metal, National Lead, and U. S. Smelting, contributed to some extent, in the order listed. In addition to copper, a feeling of optimism seems to be held by financial interests in connection with many of the other branches of the metal-mining industry, despite current metal prices. For instance, New Jersey Zinc has shown a steady advance in this calculation, since October, a condition that surely cannot be credited to the present condition of the zinc market. The March index figure for this group is a new high by some 8 points.

In the copper group, the general advance is very noticeable. Only one of the fourteen members of this group registered a loss—namely Calumet and Hecla; and one other, United Verde Extension, was unchanged. Leaders in the upward movement were Kennecott, Chile, Nevada Con., Calumet & Arizona, Granby, Inspiration, and Magma. Probably the greatest percentage of increase noted by any one company was shown by Granby. In the last issue of *Engineering and Mining Journal* for February, Granby stock was quoted at 39¾, against 50⅛ at the end of March. Granby's return to the dividend list at the rate of $4 per share may be an important factor in this increase.

The buoyant effect of the copper situation is reflected to some extent, also, in the index of the thirteen miscellaneous metal-mining companies. Cerro de Pasco and Howe Sound assisted appreciably in the small advance registered by this group, and it is not unlikely that the relative importance of their copper production had some influence in this connection. All of the lead, silver-lead, and silver-lead-zinc companies in the group declined, led by St. Joe and Tintic Standard. The gold company members were mixed, Hollinger and Cresson falling off, whereas Lake Shore, Premier, and Homestake advanced. Hollinger has shown a consistent decline since the first of the year, but Premier, the British Columbia gold-silver producer, has steadily advanced in price during that period. This upward tendency of many mining share quotations has been maintained in the face of unfavorable metal statistics.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	111.74
1926	107.74
1927	97.54

	1926	1927	1928
August	110.22	97.25	——
September	109.27	96.01	——
October	106.20	95.36	——
November	104.21	96.22	——
December	102.31	98.30	——
January	112.66	100.46	97.54
February	111.91	100.01	96.73
March	108.95	100.84	96.22

Daily world production rates of copper, lead, and zinc were higher in February, the last month for which these records are available. The copper rate, in excess of 5,000 tons, is the highest daily average figure on record. However, though February is a short month, the smelters and refineries usually make an effort to balance their monthly productions, the result being that the February daily rate always yields a high point in the graphical analysis. Working on this assumption, it is only fair to discount, partly, the new high figure. Nevertheless, the fact remains that February is an annual event, and it is only in February, 1928, that the daily production rate has exceeded 5,000 tons. March statistics should prove enlightening, and a more definite idea of actual tendency in world copper production can be had after their release.

Despite curtailment steps claimed to have been taken in the Tri-State district, daily rates of domestic production as well as world production of lead and zinc were higher in February. The lead increase is not alarming, but zinc, in company with copper, established a new high record for daily average world production. With the new electrolytic plant at Wallace, Idaho, prepared to add another increment to the zinc output in the near future, it would appear that the zinc production rate might be on its way to even higher levels.

A few concentrate sales were reported in the Tri-State district as high as $40 per ton, but that price did not prevail for long. Custom smelters in that field are finding it necessary to choose between two situations, neither of which is greatly to their liking. If the producers' demands are satisfied, the smelter is likely to find a considerable quantity of metal on hand that cost more than the slab zinc market justifies; or if the producers' demands are not met, the retorts must be shut down, and that is an expensive procedure. Hence, the smelter operator finds himself "between two fires," so to speak, one of which he does not wish to see extinguished.

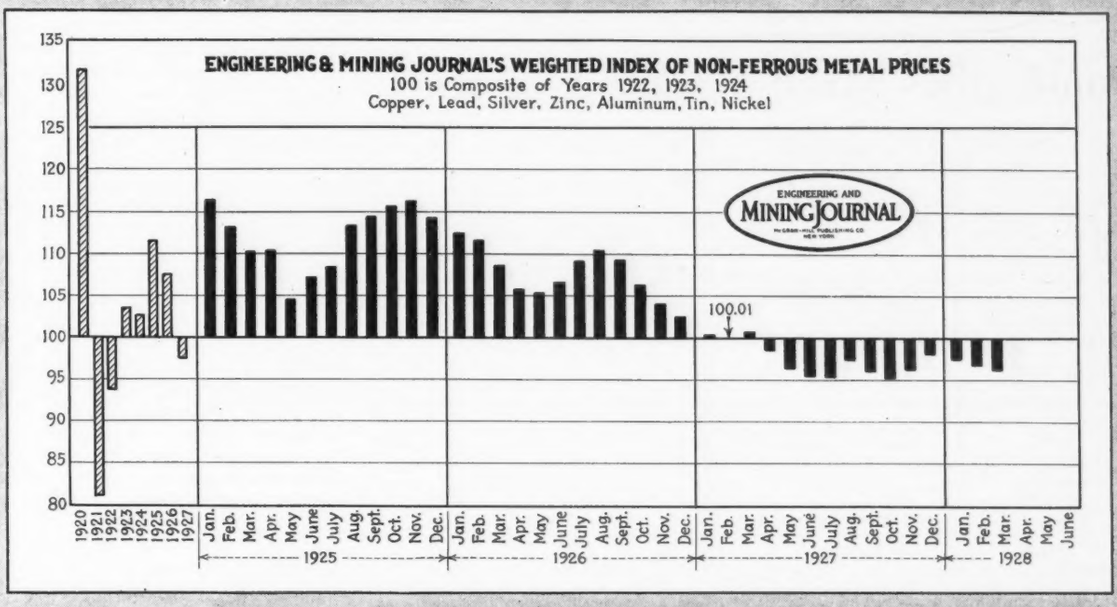
Rumors of the proposed Lead Institute continue to go the rounds, and it is not unlikely that some definite announcement will be forthcoming soon.

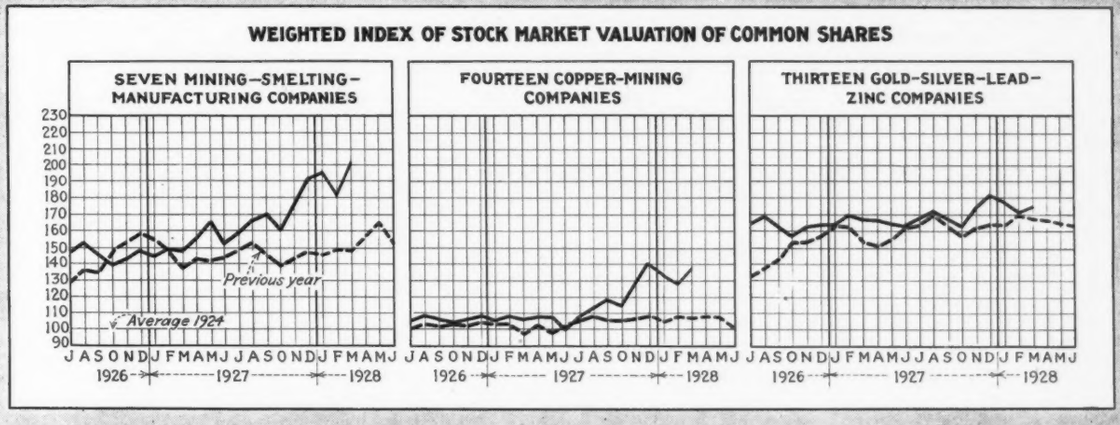
Current Statistics of Production and Stocks of Copper, Lead, and Zinc

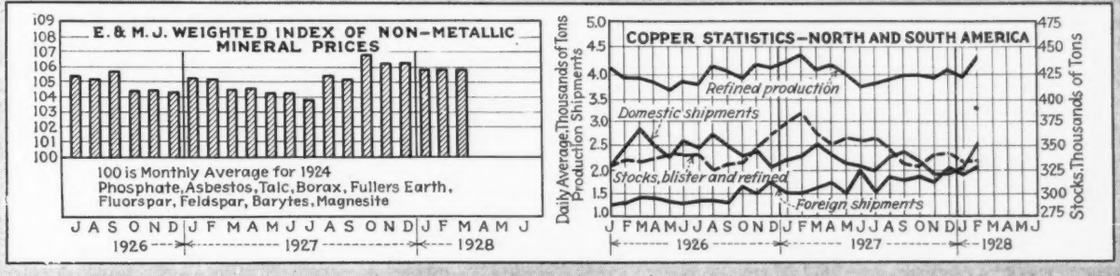
Data from American Bureau of Metal Statistics
Figures Represent Short Tons

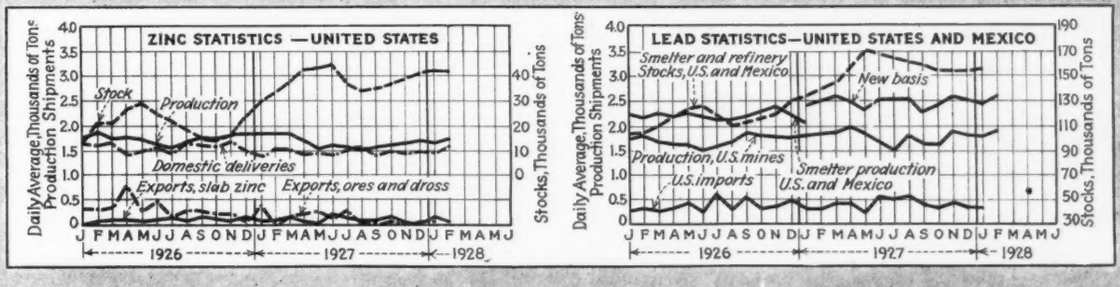
	1927			1928	
	Average	February	December	January	February
COPPER—North and South America					
Production, refined, daily average	4,045	4,368	4,159	3,959	4,305
Domestic shipments	68,737	67,564	60,862	64,824	73,789
Foreign shipments	53,489	43,690	63,637	56,721	60,603
Stocks, blister and refined	351,611	377,239	343,718	334,437	334,671
LEAD—United States and Mexico					
Production, smelter, daily average	2,513	2,567	2,517	2,479	2,642
Production, U. S. mines, daily average	1,798	1,785	1,833	1,768	1,923
Imports into U. S. A	13,451	12,307	10,587	10,418	.....
Stocks, smelter and refinery	156,878	139,824	156,280	157,417	.....
ZINC—United States					
Production, daily average	1,681	1,834	1,689	1,691	1,726
Domestic deliveries	45,811	43,555	46,483	45,771	46,754
Exports, slab zinc	3,468	2,669	1,042	4,649	2,125
Exports, ores and dross	4,424	625	2,388	2,444	.....
Stocks	37,602	32,938	40,751	42,163	41,317
World Production Rate (Daily average)					
Copper	4,543	4,720	4,805	4,534	5,014
Lead	4,514	4,548	4,456	4,339	4,523
Zinc	3,910	3,977	4,091	4,113	4,218

E.&M.J. Statistics of the Mining Industries






E. & M. J. WEIGHTED INDEX OF NON-METALLIC MINERAL PRICES
100 is Monthly Average for 1924
Phosphate, Asbestos, Talc, Borax, Fullers Earth, Fluorspar, Feldspar, Barytes, Magnesite
COPPER STATISTICS—NORTH AND SOUTH AMERICA
Refined production
Domestic shipments
Stocks, blister and refined
Foreign shipments
Daily Average Thousands of Tons Production Shipments
Stocks, Thousands of Tons
1926
1927
1928



The Market Report

Non-Ferrous Metal Markets Quieter

Copper and Tin Prices Slightly Lower but Silver, Lead, and Zinc Are Firm

New York, April 11, 1928.—The Easter holidays, during which the London metal market and the New York Stock Exchange were closed, affected the metal market to some extent apparently, though sales of lead and zinc were in fair volume. No important price changes were registered during the week, with the exception of tin, which dropped almost 2c. per pound.

The extreme activity of the New York Stock Exchange continues, but it is felt that speculative interests govern, rather than a belief that general business conditions will exhibit any correspondingly great improvement.

Daily Prices of Metals

April	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
5	14.05	52.75	6.10	5.95@5.975	5.75
6	13 90@14.025	52.75	6.10	5.95@6.00	5.75
7	13.90@14.025	52.75	6.10	5.95@6.00	5.75
9	13.90@14.025	52.50	6.10	5.95@6.00	5.75
10	13.90@13.95	51.75	6.10	6 00	5.75
11	13.90@14.025	51.875	6.10	6.00	5.725
	13.971	52.396	6.100	5.981	5.746

Average prices for calendar week ending April 7, 1928, are: Copper, 13.996; Straits tin, 53.104; N. Y. lead, 6.100; St. Louis lead, 5.969; zinc, 5.733; and silver, 57.042.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
5	61 11/16	61 3/4	66 1/2	237 1/4	238	20 1/4	20 9/16	25	24 15/16
6	Holiday	....	....	....	....	....	....	....	....
9	Holiday	....	....	....	....	....	....	....	....
10	61 13/16	61 7/8	66 1/2	235 3/8	235 3/8	20 1/4	20 7/16	24 15/16	24 7/8
11	61 11/16	61 11/16	66 1/2	230 5/8	231 1/2	20	20 5/16	24 3/4	24 3/4

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

April	Sterling Exchange "Checks"	Silver		Gold London	April	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
5	4.87 3/4	57	26 1/2	84s11 1/2d	9	4.87 13/16	57 1/8	Holiday	.....
6	4.87 13/16	57	Holiday	.....	10	4.87 13/16	57 1/8	26 1/4	84s11 1/2d
7	4.87 3/4	57	Holiday	.....	11	4.87 13/16	57 1/4	26 5/16	84s11 1/2d
					Avg.		57.083		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Copper Is Neglected

Copper has entered another period of quiet such as characterized the early weeks of the year, with the same conditions predominating; that is, the primary producers are firm at one price, with only an occasional sale, while concessions are offered by others who make it a practice to sell an appreciable tonnage every week. The level of the market, however, is 1/8c. above that which obtained during the first quarter, most sellers now quoting 14 1/4c. for Eastern deliveries, and 14 3/8c. in the Middle West. A good portion of the week's business has been placed below these levels, however, even as low as 14 1/8c. having been accepted for particularly attractive orders, though this cannot be said to be the general market. The total volume of business has been the smallest for six weeks. No great demand is expected for some weeks, as it is probable that consumers are pretty well covered for April, and many for May, also.

The foreign market has been better, relatively, than the domestic, even with the Friday to Monday holiday. On each business day, sales were good at 14 1/2c., c.i.f. The recent improvement in buying has been especially notable in Russia, France, and England. The continued activity in the foreign market is particularly encouraging to producers, who feel that this will bridge the gap between the waves of domestic buying.

Most of the Zinc Brings 5 3/4c.

Galvanizers were somewhat more active buyers this week than they have been recently, and the indications are that they are not particularly well covered. Several rather large sized orders were placed, the prices running from 5.725c. for prompt to 5.775c. for June in most instances. In the following March statistics, released by the American Zinc Institute, the daily rate of production increased from 1,750 tons in February to 1,800 in March; as the retorts in operation decreased by 1,065, it is evident that more than the entire increase can be laid to electrolytic production.

	Tons of 2,000 Pounds
Stock, March 1.....	41,290
Produced	55,881
	97,171
Shipped	55,642
Stock, March 31.....	41,529
Sold, not yet delivered....	25,926
Average number retorts operating, March.....	71,151
Number of retorts operating March 31.....	71,252

The weighted average selling price of Prime Western as reported by the Institute was 5.610c. per pound, which compares with the *E. & M. J.* average of 5.624c.

Normal Lead Business, Prices Firm

Lead enjoyed a normal week, although the volume of sales was slightly below

the average recently established. In general prices were unchanged. All lead sold in the East was on the basis of 6.10c. New York, the American Smelting & Refining Company's contract price. In the Middle West some lead was sold below last week's closing quotation of 5.975c., and a considerable tonnage was sold at 2½ points above that figure. Several of the large sellers have disposed of the greater part of their April metal, and at least one interest is temporarily out of the market. Weakness in London has tended to offset this situation, however. Taking everything into consideration, the condition of the market appears virtually unchanged from a week ago.

Much depends on whether foreign consumption of lead can be maintained or improved. The London price of spot lead relapsed to £20 today, which is not particularly encouraging.

Corroding grades command the usual premium of $2@$3 per ton in the domestic market. A fair demand from paint manufacturers has been in evidence recently.

Tin Shows Weakness in Dull Market

Tin is suffering a reaction from the recent sharp advance. Prices were nominal over the Easter holidays, and all sales reported since then have been at lower levels, with little metal changing hands. Today, the market stiffened somewhat and there is a slightly stronger undertone, with better than 52c. being realized on some business late in the day. The 99 per cent grade continues to be entirely nominal.

Silver Firmer

During the first half of the week the silver market remained steady but dull on account of the Easter holidays abroad. China and India have since shown some interest as buyers in the local market, resulting in a somewhat firmer tone with limited offerings, which has brought the price up to today's quotation of 57¼c.

Mexican Dollars (Old Mexican pesos): April 5th, 6th, and 7th, 43⅝c.; 9th and 10th, 43¾c.; 11th, 43⅞c.

Foreign Exchange Steady

Closing cable quotations for the principal foreign exchanges, other than Sterling, on Tuesday, April 10, follow: francs, 3.93¾c.; lire, 5.28c.; and marks, 23.92c. Canadian dollars, ⅝ per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

ALUMINUM—Per lb., 98 or 99 per cent grades, price of leading interest, 24.30c.; outside market, 23.90@24.30c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, for all positions, 9⅝c.

Cookson's "C" grade, spot, 15⅜c. Needle antimony nominally 7¼c. for lump and 10c. for powdered. White oxide, Chinese, 99 per cent Sb_2O_3, 11¼c.

BISMUTH—Per lb., New York, in ton lots, $2.10. Smaller lots, $2.25 and up.

IRIDIUM — Per oz., $275@$300 for 98@99 per cent sponge and powder. Market dull, prices largely nominal.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $46@$49. Small lots bring up to $55. Absolutely no activity in market.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $80. Dealers and refiners quote the trade for refined metal, per oz., cash, $74@$76. Market very dull.

QUICKSILVER — Per 76-lb. flask, $123@$124, depending on quantity. Market firm. San Francisco wires $121.67.

Prices of Cadmium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of April 7.

Metallic Ores

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn: 35@38c. Caucasian, washed, 53@55 per cent, 38@40c. Chemical grades unchanged from quotations in the April 7 issue.

TUNGSTEN ORE—Per unit of WO_3, N. Y.; Wolframite. $10.25@$10.50. Western scheelite, $10.50@$10.75. Prices nominal.

Chrome, Iron, Tantalum, and Titanium ores are unchanged from quotations in the April 7 issue.

Lead Ore Advanced $5 in Joplin

Joplin, Mo., April 7, 1928

Blende	Per Ton
High	$41.00
Premium blende, basis 60 per cent zinc	$39.00@ 40.00
Prime Western, basis 60 per cent zinc	38.00
Fines and slimes, basis 60 per cent zinc	35.00@ 37.00
Galena	
High	$78.30
Basis 80 per cent lead	77.50

Shipments for the week: Blende, 9,874; lead, 1,006 tons. The number of mills shut down this week equals the number restarted, but the total tonnage production was 320 tons greater.

Restriction continues, however, apparently methodically, but not without the usual grumbling of some dissatisfied producers, who contend that five companies own two-thirds of the reserve tonnage, but are not observing that quota of the restriction.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the April 7 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic)—Per lb., 4c. Market quiet.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the April 7 issue.

Ferro-Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $100 quoted for second quarter, 1928. Spiegeleisen, 19@21 per cent, $32 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent, 92@95c. f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, and Ferrovanadium are unchanged from prices in the April 7 issue.

Metal Products

ROLLED COPPER—Sheets, 23c.; wire, 16c. per lb., f.o.b. mill.

LEAD SHEETS—Full rolled, 9¼c. per lb.; clipped, 10c.

NICKEL SILVER—29¼c. per lb. for 18 per cent nickel Grade A sheets.

YELLOW (MUNTZ) METAL—Dimension sheets, 19¾c. per lb.; rods, 16¾c. per lb.

ZINC SHEETS—8½c. per lb., f.o.b. works.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of April 7.

Iron, Steel, and Coke

Iron—Per gross ton, Valley furnaces, Bessemer, $17.50; basic, $17; No. 2 foundry, $17.25.

Steel—Base prices per gross ton, Pittsburgh, billets and slabs, $33; plates, structural shapes, and soft steel bars, per pound, 1.85@1.90c.

Coke—Per gross ton, Connellsville furnace, contract, $2.75@$3; spot, $2.60@$2.75. Connellsville foundry, contract, $3.75@$4.25; spot, $3.75@$4.25. By-product coke, Ohio and Kentucky, $7; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended April 7, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	66⅛	61¼	66⅛	Ap.14, My.20 Q	0.75
Arcadian Consol	Boston	...	...	5¼	...	...
Ariz. Com'l	Boston	4⅛	4	4¼	Ja. 19, Ja. 31	0.25
Cal. & Ariz	New York	106¾	100⅛	102⅞	...	...
Calumet & Hecla	Boston	22	21⅛	21⅛	No.30, De.15 Q	0.50
Cerro de Pasco	New York	67⅛	66⅛	66	Ap.12, My.1 Q	1.00
Chile Copper	New York	41⅛	40⅛	41⅛	Ma. 2, Ma.30 Q	0.26
Con. Copper mines	N. Y. Curb	11⅜	10⅞	11	...	...
Copper Range	Boston	17	16	16⅛	Ap.2, Ma.2, A	1.00
Crystal Copper	Boston Curb	86	75	83	...	...
East Butte	Boston	2	1⅛	2	Dec., 1919	0.50
Granby Consol	New York	51⅜	49⅛	49⅛	Ap.13, My.1 Q	1.00
Greene Cananea	New York	133¾	125⅛	132⅛	Nov., 1920	0.50
Howe Sound	New York	52⅛	49⅛	52⅛	Ma.31, Ap.16, Q	1.00
Inspiration Consol	New York	20⅛	19⅝	20⅛	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	2⅛	2⅛	2⅛	...	...
Isle Royale	Boston	13⅞	13⅛	13⅛	Fe.28, Ma.15	0.50
Kennecott	New York	86⅛	83⅛	85⅛	De.2, Ja.3 Q	1.25
Magma Copper	New York	51⅛	49	49⅛	Ma.31, Ap.16 Q	0.75
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛	...	...
Miami Copper	New York	19⅛	18⅛	19	My.1, My.15, Q	0.37½
Mohawk	Boston	60½	53	60	Ja.28, Ma.1 Q	1.00
Montana-Idaho	Spokane	*50½	*42½	*42½	...	...
Mother Lode Coal	New York	3⅛	3	3⅛	De.16, De.31	0.25
Nevada Consol	New York	21⅞	20⅜	20⅛	Ma.16, Ma.31 Q	0.37½
New Cornelia	Boston	29	26½	28	Fe.3, Fe.20 Q	0.50
Noranda	N. Y. Curb	17⅛	17⅛	17⅛	...	...
North Butte	Boston	2	1 1/16	2	Oct., 1928	0.25
Ohio Copper	N. Y. Curb	*85	*80	*81	Sept., 1926	0.03
Old Dominion	Boston	12	9⅜	12	Dec., 1928	1.00
Phelps Dodge	N. Y. Curb	128⅛	126	128⅛	De.17, Ja.3 Q	1.50
Quincy	Boston	13⅛	13	13	March, 1920	1.00
St. Mary's Min. Ld	Boston	27	26	26⅛	Fe.10, Ma.10	2.00
Seneca Copper	New York	2⅛	2⅛	2⅛	...	...
Shattuck-Denn	N. Y. Curb	15⅛	14⅜	15⅛	...	...
Tenn. C. & C	New York	12	11⅛	11⅜	Fe.29, My.15,Q	0.12½
United Verde Ex	N. Y. Curb	20⅛	19⅜	20	Ap.6, My.1, Q	0.50
Utah Copper	New York	140	140	140	Ma.16, Ma.31 Q	0.50
Utah Metal & T	Boston	1⅜	1⅛	1⅛	Dec., 1917	0.30
Walker Mining	Salt Lake	*80	*75	*78	...	...
NICKEL-COPPER						
Internat. Nickel	New York	95⅜	90⅞	92⅜	Ma.15, Ma.31Q	0.50
Internat. Nickel pfd	New York	113	113	113	Ap.12, My.1 Q	1.50
LEAD						
Gladstone Mtn	Spokane	*11⅛	*8	*8	June, 1927	0.005
National Lead	New York	132	129	131	Ma.16, Ma.31Q	1.25
National Lead pfd	New York	147	147	147	Ap.23, Ma.1 Q	1.50
National Lead,pfd. B	New York	120	120	120	...	...
St. Joseph Lead	New York	40⅛	39⅛	39⅛	Jn.9, Jn.20, QX	0.75
ZINC						
Am. Z. L. & S	New York	24⅛	21⅛	23⅜	May, 1917	1.00
Am. Z. L. & S. pfd	New York	92⅜	84	91⅛	Nov., 1920	1.50
Butte C. & Z	New York	6	5	6	De.9, De.24	0.50
Butte & Superior	New York	11⅜	10⅛	11⅛	De.16, De.31 Q	0.50
Callahan Zn-Ld	New York	2⅜	2⅛	2⅛	Ma.14, Ma.31	0.50
Consol.Lead&Zinc 'A'	St. Louis	13	12⅛	12⅛	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	18⅛	17⅛	18	No.15, De.1 Q	0.40
Eagle-Picher pfd	Cincinnati	102	102	102	Jn.30, Oc.15 Q	1.50
New Jersey Zn	N. Y. Curb	197⅛	196	197	Ma.31, Ap.16 Q	1.50
Treadwell-Yukon	Toronto	25.75	25 00	25.25	...	...
United Zinc	N. Y. Curb	..	...	25	...	...
Yellow Pine	Los Angeles	..	..	*25	Dec., 1925 Q	0.04
GOLD						
Alaska Juneau	New York	3⅛	⅜	3⅛	...	...
Argonaut	Toronto	*1⅜	*15⅛	*18	...	...
Barry-Hollinger	Toronto	1.43	1.24	1.41	...	...
Central Manitoba	Toronto	1.54	1.35	1.35	...	...
Con.W.Dome L. new.	Toronto	*10⅛	*10	*10⅛	...	...
Cresson Consol. G	N. Y. Curb	1⅞	1⅜	1⅞	Ma.31, Ap.10 Q	0.10
Dome Mines	New York	10⅞	10⅛	10½	Ma.31, Ap.20 Q	0.25
Golden Cycle	Colo.Springs	†1.75	†1.73	....	Fe.29, Ma.10 Q	0.04
Gold Hill	Toronto	*23⅛	*21	*21⅛	...	...
Hollinger Consol	Toronto	17.00	16.80	16.80	Ap.4, Ap.21	0.10
Homestake Mining	New York	...	...	73⅛	Ap.20, Ap.25 Q	0.50
Kirkland Lake	Toronto	2.05	1.96	2.04	...	...
Lake Shore	Toronto	24.46	24.10	24.25	Ma.1, Ma.15QX	0.20
McIntyre-Porcupine	New York	...	...	26⅛	Fe.1, Ma.1 Q	0.25
Portland	Colo.Springs	†*25	†*15	...	Ap.6, Ap.15 Q	0.02
Rand Mines	New York	...	...	40⅜	Au.22-29 Am.Sh.	1.52
Sylvanite	Toronto	3.25	3.15	3.15	...	...
Teck-Hughes	Toronto	9.10	8.55	9.00	Fe. 1, X	0.15
Tom Reed	Los Angeles	*32½	*32½	*32½	Dec., 1926	0.02
Tough-Oakes	Toronto	*62	*53	*55	...	...
United Eastern	N. Y. Curb	*55	*55	*55	July, 1924	0.05
Vipond Cons	Toronto	*81	*65	*70	Ap.1, Ap.15	0.03
Wright-Hargreaves	Toronto	4.80	4.55	4.75	Ap.13, My.1	0.05
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	26	25	25⅜	...	...
Con. Cortez	N. Y. Curb	*24	*24	*24	...	...
Dolores Esperanza	N. Y. Curb	...	...	*31	July, 1923	0.05
N.Y. Hond'a Rosario	N. Y. Curb	16⅜	16⅛	16⅜	...	...
Premier Gold	N. Y. Curb	2⅜	2 3/16	2⅜	Ma.15, Ap.4	0.08
Tonopah Belmont	N. Y. Curb	1⅛	1⅛	1⅛	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*13	*11	*13	Ma.1, Ap.21	0.07½
Tonopah Mining	N. Y. Curb	4⅜	4⅛	4⅛	Mar.,31 Ap. 21	0.07½
West End Consol	N. Y. Curb	*6	*6	*6	Mar., 1923	0.05
Yukon Gold	Boston Curb	*94	*77	*77	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	1.66	1.59	1.60	May, 1920	0.03
Castle-Trethewey	Toronto	*62	*60	*60	...	...
Coniagas	Toronto	5.10	5.00	5.00	May, 1924	0.12½
Keeley	Toronto	*63	*60	*60	Ma.1, Ma.15	0.04
Lorrain Trout Lake	Toronto	...	...	*30	July, 1925	0.05
Mining Corp. Can	Toronto	3.50	3.30	3.50	Ja.10, Ja.25	0.15
Nipissing	N. Y. Curb	4⅜	4⅛	4⅛	Ma.31, Ap.20Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	5⅜	4⅜	4⅜	Ma.25, Ap.4QX	0.12½
Bingham Mines	Boston	53⅛	52	53	Ma.22, Ap.5 Q	1.00
Bunker Hill & Sullivan	N. Y. Curb	...	...	143	Ma.31, Ap.4 X	0.75
Cardiff M. & M	Salt Lake	*85	*75	*75	Feb. 5, 1927	0.10
Chief Consol	Salt Lake	4.10	3.90	4.02½	Ja.10, Fe.1 Q	0.10
Consti'n Mng.&Mill'g.	Spokane	*22	*18	*22	...	...
Erupcion	Boston Curb	...	...	*30	Ap. Q	0.07½
Eureka Lily	Salt Lake	1.85	1.77½	1.77½	...	...
Federal M. & S	New York	...	...	138	Jn.25, Jn.29	Spec. $10
Federal M. & S. pfd	New York	94⅜	94⅛	94⅛	Fe.24, Ma.15 Q	1.75
Hecla Mining	N. Y. Curb	15⅜	15⅛	15⅜	Fe.15, Ma.15 Q	0.25
Highland-Surprise	Spokane	*13	*12	*12	...	...
Iron King Mining	Salt Lake	*72	*61	*63	...	...
Keystone Mining	Salt Lake	...	...	*35	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*40	*39	*39	...	...
Lucky Tiger-Com	Kansas City	†7.95	†7.80	...	Ma.10, Ma.20X	0.07
Mammoth Mining	Salt Lake	1.65	1.65	1.65	Jn.10, Jn.20 Q	0.05
North Lily	Salt Lake	6.50	6.35	6.35	...	...
Park Utah	New York	11⅛	11⅛	11⅛	Ma.15, Ap.15 Q	0.20
Plutus Mining	Salt Lake	...	...	2.50	Oc.25, No.10 Q	0.10
Silver King Coal	Salt Lake	11.50	10.50	11.25	Ma.20, Ap.2	0.25
Silversmith	Spokane	*19	*18	*18⅛	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*46⅛	*45	*45	...	...
Sunshine M. Co	Spokane	1.50	1.40	1.50	Fe.10, Fe.20	0.02
Tamarack-Custer	Spokane	*92	*85	*92	Sept., 1924	0.25
Tintic Standard	Salt Lake	14	13⅜	14	Ma.21, Ma.29Q	0.30
Utah-Apex	Boston	4⅛	4⅛	4⅛	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	59⅜	57⅛	59	Se. 2, Oc. 1.	1.75
Cleveland-Cliffs Iron	Cleveland	115	114⅜	114⅜	Ja. 13, Ja. 25. Q	1.00
Colorado Fuel & Iron	New York	77⅛	74	75⅛	May, 1921	0.75
Gt. North'n Iron Ore	New York	23⅛	22⅛	23	Dec. 6, Dec. 28	0.75
Inland Steel	New York	55	52⅜	55	Fe. 15 Ma. 1 QX	0.66⅔
Republic I. & S	New York	60⅜	59⅜	60⅛	Fe. 15, Ma. 1 Q	1.00
Republic I. & S. pfd	New York	...	...	110	Ma. 15, Ap. 2 Q	1.75
Sloss-Sheffield S. & I	New York	123	123	123	De. 10, De. 20 Q	1.50
Sloss-Snef. S.&I. pfd	New York	119	119	119	De. 20, Ja. 3 Q	1.75
U. S. Steel	New York	148	145⅛	147⅛	No. 30, De. 30 Q	1.75
U. S. Steel, pfd	New York	145⅛	145⅛	145⅛	Oc. 30, No. 29 Q	1.75
Virginia I. C. & C	New York	...	...	32	Jan., 1924	1.50
Virginia I.C.&C. pfd	New York	...	...	60	De. 16, Ja. 3	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol	New York	26⅛	26⅛	26⅛	Jn. 26, Jn. 30	1.45
So. Am. G. & P. New	N. Y. Curb	...	...	3⅛	...	...
Alum. Co. of Amer	N. Y. Curb	128	125	128	...	...
Alum. Co. of Amer. pf.	N. Y. Curb	108⅜	108⅛	108⅜	Ma. 15, Ap. 1 Q	1.50
Vanadium Corp	New York	87⅛	83⅜	85⅛	Fe. 1, Fe. 15 Q	0.75
Patino M. & E	New York	32⅛	28⅜	29	De. 31, Ja. 14	4s.
ASBESTOS						
Asbestos Corp	Montreal	33	30⅜	32	Jan., 1926	1.50
Asbestos Corp. pfd	Montreal	93⅛	91	93⅛	Ma. 31, Ap. 16 Q	1.75
SULPHUR						
Freeport Texas	New York	83⅞	81⅛	83⅛	Ap.14,Ma.1QX	1.75
Texas Gulf	New York	76⅛	74⅛	74⅛	Ma. 1, Ma. 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	44	43⅛	43⅛	Fe. 18, Ma. 1 Q	0.75
Amer. Metal, pfd	New York	125	123	123	Fe. 18, Ma. 1 Q	1.75
Amer. Sm. & Ref	New York	190⅜	184⅜	186⅛	Ap.13, My.1 Q	2.00
Amer. Sm. & Ref. pfd	New York	140⅛	140	140⅛	My. 4, Jn. 1 Q	1.75
Consol. M. & S	Montreal	278	271	275	De. 31, Ja. 16 X	6.25
Newmont Mining	N. Y. Curb	172	162	169⅜	Ma.31, Ap.16 Q	1.00
U. S. Sm. R. & M	New York	43⅛	42	42	Ap.5, Ap.14 Q	0.87½
U.S. Sm. R.&M. pfd	New York	53⅜	53⅞	53⅞	Ap.5, Ap.14 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED MARCH 27, 1928

Name	High	Low	Last	Date	Last Div. Amount
Aramayo Mines (25 frs.)	63/1¼	61/10½	62/6	Feb., 1928	5 p.c. (†)
Burma Corpn. (10 rupees)	13/3	12/9	13/—	Jan., 1928	6 annas*
Bwana M'Kubwa (5s)	5/6	4/1¼	5/3	...	...
Camp Bird (2s)	5/10½	5/—	5/1½	April, 1928	6¼ p.c.
El Oro (£1)	4/4½	4/—	4/3	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£1)	14/3	13/9	13/9	Jan., 1928	5 p.c.
Mexican Corpn.(£1)	11/1½	10/1½	10/3	...	...
Mexico Mines of El Oro (£1)	29/4½	25/—	26/3	Dec., 1926	3¾ p.c.*
Mond Nickel	191 10½	146 3	147 6	Feb., 1928	7½ p.c.
N'Changa Copper Mining	10/—	10/—	10/—	...	...
Oroville Dredging (£1)	4/—	3/3	4/—	Dec., 1923	3¾ p.c.
Rhodesian Congo Border (£1)	18/9	18/1½	18/9	...	...
St. John del Rey (£1)	12/9	12/1½	12/6	May, 1927	3¾ p.c.
San Francisco Mines (10s)	28 1½	27/—	27/9	Jan., 1928	25s.
Santa Gertrudis (£1)	18/—	16/—	16/3	Jan., 1928	7½ p.c.
Selukwe (2s. 6d.)	10/6	9/4½	10/4½	April, 1917	6¼ p.c.
S. Amer. Copper (2s.)	1/8	1/6	1/6	Nov., 1917	75 p.c.
Tanganyika (£1)	66/9	63/1½	63/9	Aug., 1927	7½ p.c.
Union Miniere de Haut-Katanga (Brussels)	7,787.50	7,550	7,550	July, 1927	182.60 (‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.